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Railways, Electric Railways, Elevated and Cable Railways, Horse and Motor Railways, Highways, Bridges, Tunnels and Canals, Water-Works, Irrigation, Sewers, Streets, Electrical, Contract Prices, Miscellaneous, Manufacturing and Technical, Current Price List.

The experiments on flying machines which were being carried on by Mr. Hiram Maxim, the American inventor, are reported as abandoned, for the present at least, no further capital being available for their continuance. This is to be regretted, since of the many inventors who are working on this difficult problem, Mr. Maxim was one of the very few who attacked it in an intelligent and scientific manner. The result he had already attained were described in our issue of Oct. 3, 1891.

The railways of Canada aggregated 14,663 miles in length at the end of July, 1891, according to a recent government report. The average rate of increase during the last ten years has been about 760 miles per annum.

The Abt rack-rail system has been adopted for the Nilgiri Railway, in India, the construction of which is now in progress. The line will be 16½ miles long, starting from Metapolitam, on the Madras Railway, and will run to Coonoor. It was at first intended to use the Fell center-rail system, used in New Zealand, but the Abt rack-rail system has been adopted as more practicable. Mr. Weightman is Chief Engineer.

A New York State Canal Convention is to be held in the autumn under the arrangement of the Union for the Improvement of the Canals of the State of New York, of which George Clinton, of Buffalo, is President, and Frank S. Gardiner, of New York, Secretary. All citizens, companies, etc., interested in the improvement of the canals and the holding of the convention are requested to communicate with the Canal Improvement Union, 55 Liberty St., New York.

The block signal plant will soon be commenced between Albany and Buffalo, N. Y., on the New York Central R. R. The company has put in the foundations for 104 two-story signal cabins, from 8 x 8 ft., to 12 x 16 ft., in plan, and contracts will be let for the frame superstructures. There will be 73 iron signal bridges across the four tracks, and on these will be placed the smallest cabins.

The breakage and wear of steel rails is the subject of a report to be presented at the International Railway Congress at St. Petersburg, by Mr. Bricka, Chief Engineer of the State Railways of France, and Mr. Busschere, Chief Engineer of the Belgian State Railways. Information will be presented from several European railways.

The Lindner system of compound locomotives was described in our issue of June 16, and up to the present time 335 engines have been built on this system, 153 having been built by one company. The number includes 37 express engines, 21 passenger engines, 221 freight engines, 46 tank engines, and 12 double-truck engines. They are used on railways with gages ranging from 1 meter to 5 ft. The boiler pressure ranges from 170 to 213 lbs. per sq. in.

The most serious accident of the week was a head collision August 1, at Edwardsville Junction, Ill., on the Cleveland, Cincinnati, Chicago & St. Louis Ry. An eastbound passenger train had orders to wait at Edwardsville Crossing for a westbound freight train, but as the latter was behind time the engineman of the passenger train pulled out, and, as usual in such cases, came into collision with the freight train. Two men were killed and several injured. The accident was due entirely to engineman's disobedience of orders.—A serious rear collision occurred in the union station at Milwaukee, Wis., July 31. The second section of a passenger train on the Chicago, Milwaukee & St. Paul R. R. was run into the station on the track already occupied by the first section. Two empty cars at the rear of the first section were telescoped, and the combination baggage and smoking car next to the engine of the second section was partly telescoped by the tender. One man in this car was killed and nine injured. The responsibility for the accident is laid upon the switchman in the yard.

An accident to a temporary bridge at Dundas St., Toronto, Ont., occurred July 22, for the following particulars of which we are indebted to Mr. C. H. Rust, Assistant City Engineer, the newspaper accounts having been quite incorrect:

We are erecting a new iron bridge at Dundas St., and during the construction it was necessary to place a temporary bridge parallel to the present old wooden bridge to accommodate the traffic. The distance between the temporary and the old bridge is about 15 ft., and we were using some of the lumber from the old bridge to erect this temporary structure, and having constructed the bents we were skidding the stringers from the old to the temporary bridge. To enable us to do this, a platform was built and the failure of this platform caused the accident. In carrying over a large stick of timber the supporting piece of the old bridge toppled over, thereby breaking the end of the temporary bridge, which fell about 20 ft., injuring about seven men, but fortunately none fatally. The new iron bridge being built is a Warren girder in five spans of from 64 ft. to 103 ft., giving 30 ft. clear roadway between the curbs and 7-ft. sidewalks outside the main trusses. The intermediate supports are lattice steel columns and masonry abutments.

A two-cylinder locomotive built by the Cooke Locomotive & Machine Co., Paterson, N. J., has been running experimentally on the New York, Lake Erie & Western R. R., as already noted in our columns, and has been tried in passenger and freight service. It has recently hauled a passenger train over the Pennsylvania R. R. to Chicago, and is to be tried on the Illinois Central R. R. The engine is of the ten-wheel type, and is a two-cylinder compound, without an intercepting valve, the first admission of steam being controlled by a connection with the throttle valve lever, as in the Lindner system (Eng. News, June 16). The cylinders are 19 x 24 ins. and 27 x 24 ins., driving wheels 4 ft. 6¾ ins. diameter, and the weight of the engine is about 128,000 lbs.

The dimensions of the new steamers being built by the Fairfield Shipbuilding & Engineering Co. for the Cunard Line are given in the accompanying table, together with those of the other principal steamers running between New York and Liverpool. They will be named the "Campania" and "Lucania."

The first four belong to the Cunard Line, the "City of New York" and "City of Paris" to the Inman Line; the "Majestic" and "Teutonic" to the White Star Line, and the "City of Rome" to the Anchor Line. The new Cunarders are expected to cross in 5 days, which means a speed of over 23 knots per hour, over the usual course of 2,780 knots.

	Length. ft.	Beam. ft.	Depth. ft.	Tonnage.	I. HP.
"Campania" and "Lucania"	600	65	43	13,000	25,000
"Umbria" and "Etruria"	500	57	40	7,720	14,500
"City of New York" and "City of Paris"	560	63	42	10,500	18,000
"Majestic" and "Teutonic"	582	57½	39½	10,000	17,000
"City of Rome"	560	52	37	8,144	10,100

The indicator valve post described in our issue of July 21, we are informed, is made by the Chapman Valve Co., of Indian Orchard, Mass., as well as by R. D. Wood & Co., Philadelphia. It was stated to us on good authority that the post was made only by R. D. Wood & Co., under arrangement with the patentee. There are some small differences of detail which may make the two different articles in the technical sense, but practically they appear to be almost identical.

The Connelly gas motor, which has been in use experimentally on street railway lines in Chicago, controlled by the Yerkes' syndicate for two years, is to be put into service quite extensively in connection with the Chicago cable lines.

Motor cars fitted with the gas engine and apparatus are to be run on feeders to the cable lines, which are now operated by horse cars, and are also to be run on the cable lines between the cable motors during the rush hours. It is stated that about 20 of the motors are now being built.

The success of the Connelly motor is due largely to the use of a very ingenious variable speed gearing between the motor and the driving axle, by which the leverage of the motor is varied at will by the driver. The rocks on which most mechanical motors for street cars have split is that a large motor is necessary to start the car when heavily loaded, while only a small amount of power is absorbed when the car is under way, on a level track. With the Connelly motor the variable speed gearing enables an engine of only about 10 HP. to run a motor car drawing one trailer over ordinary grades. Part of the new motors now being built for Chicago lines will be of 10 HP. and part, which are intended to run on the cable lines and draw two trail cars, will be of 20 HP. The new motors are to be built by the Connelly Motor Co., of Illinois, a corporation in which Mr. C. T. Yerkes and his associates have purchased a controlling interest.

The perfection to which the manufacture of fluid compressed, hydraulic forged, open hearth steel has been brought is well illustrated by the following table of heavy steel forgings, recently issued among others, by the Bethlehem Iron Co., showing the number and dimensions of these forgings used on two ships only:

For U. S. S. "Columbia."

		Length Ft.	Length Ins.	Diam. Ins.	Diam. Hole. Ins.	Approx. Wgt. Each, Lbs.
3	Propeller Shafts	38	10½	16	7½	20,000
1	Line "	18	4	15¾	7½	12,600
2	" "	10	3	15¾	7½	6,500
2	Thrust "	19	9⅜	15¾	7½	15,000
1	" "	20	2¼	15¾	7½	18,000
2	Stern "	35	1	16¼	7½	20,000
10	Crank "	9	7½	16	7½	9,100
3	Reverse "	10	⅛	7⅝	3½	1,200
3	" "	15	6⅝	7⅝	3½	2,000
9	Connecting Rods	7	9¾	....	...	4,000
9	Piston "	8	7½	....	...	1,500
9	Crossheads	..	....	....	...	1,000
18	Connecting Rod Caps	..	....	....	...	175
18	Engine Columns	9	1	8	4½	1,425

For U. S. S. "New York."

		Length Ft.	Length Ins.	Diam. Ins.	Diam. Hole. Ins.	Approx. Wgt. Each, Lbs.
2	Propeller Shafts	41	16	17¼	7½	27,400
2	Line "	28	....	17¼	7½	18,500
2	Thrust "	21	....	16¾	7½	18,025
12	Crank "	..	....	....	...	.....
	Forward Engine:					
	2 High Pressure	7	2	13½	6	4,950
	2 Low "	7	2	13½	6	5,2 5
	2 Intrm'te "	9	4	13½	6	6,180
	After Engine:					
	2 High Pressure	7	8	17	7	8,6 0
	2 Low "	7	2	17	7	8,490
	2 Intrm'te "	9	4	17	7	10,420
4	Reverse Shafts	17	1½	7	2⅝	1,770
2	Disconnect'g Shafts	5	3¾	13½	6	3,820
12	Connecting Rods	5	10	....	...	
12	Piston "	8	....	....	...	840
2	Sliding Couplings	..	....	....	...	1,770
12	Conct'g Rod Caps	..	....	....	...	400
12	Crossheads	..	....	....	...	570

The engineering committee of the Chicago Board of Drainage Trustees has recommended that the chief engineer be given authority to investigate the recent flood in the Illinois valley. Mr. Cooley has made a report stating that the water of the main channel will flow through the Illinois valley, imposing upon the board liability of flood damages arising out of its construction, hence suggesting the need of technico-legal data bearing upon floods; that the problem of navigation would be immeasurably simplified if such data were in hand, and that the general improvement of the Illinois River required consideration of such hydrographical data.

Fast runs are reported as having been made on the Philadelphia & Reading R. R. recently. On four days the Lehigh Valley R. R. engine No. 615 hauled the Royal Blue express, consisting of four or five cars, over the Philadelphia & Reading R. R. between Philadelphia and Jersey City. Each day the train was seven to eight minutes late leaving Wayne Junction, which is on the outside of Philadelphia, but it arrived at Bound Brook on time—55 miles in 52 minutes. The distance from Wayne Junction to Jersey City is 85 miles, and it was covered in 82 minutes. The fastest mile was made in 42 seconds, or at the rate of nearly 86 miles per hour, as shown by the speed recorder. The engine was built in the South Easton shops.

SEWAGE PURIFICATION IN AMERICA.

(Continued from page 78.)

Purification in the Drainage Area of the Boston Water-Works.

The efforts of Boston to prevent the pollution of the city water supply, coupled with the authority of the Massachusetts State Board of Health and the final though perhaps somewhat tardy co-operation of the towns concerned, have resulted in the establishment of a sewage purification plant at South Framingham, which is probably the most successful in the country and compares favorably with any in existence elsewhere. In addition a second plant at Marlboro, which will doubtless prove successful, has recently been put in operation, and a third at Westboro is now under construction in the drainage area of the Boston water-works. Perhaps Boston's part in connection with these plants has been more in the line of inducing the towns to build systems which would remove the sewage entirely out of its watershed, as in any case it is probable that purification would have been necessary under the laws of the state. Toward the cost of each of these plants Boston has contributed largely, or agreed to, although under no legal obligation to do so. A sewage system is now projected for Natick, whose natural drainage is into Lake Cochituate. In addition the city has for some years treated chemically the sewage of several tanneries in the Mystic River drainage area.

As early as 1879 Mr. Desmond Fitz Gerald, M. Am. Soc. C. E., of the Boston water-works, to whose reports we are indebted for some of this information, began to urge the importance of excluding sewage from the sources of the water supply of Boston. Mr. Fitz Gerald made numerous reports on the subject, and after several years the Water Board were enabled by energetic action in the courts, to carry out his plans and suggestions.

From the start an effort was made to exclude sewage from the streams tributary to the main sources of supply. Several times the city was beaten in the lower courts, but finally the State Supreme Court rendered a decision which established the city's power to prevent the direct contamination of its water supply by turning sewage into it. The decision was rendered in the "Case of Augustus P. Martin, Mayor of Boston, vs. Luther Ellis Gleason," the Mayor of Boston having applied for an injunction to prevent Mr. Gleason from discharging the sewage from a hotel in Natick directly into Pegan Brook, which brook empties into Lake Cochituate, one of the sources of the Boston water supply.

The case is so important in sanitary history that some space may be profitably devoted to it here, the citations being from the report of the Boston Water Board for the year ending April 30, 1885.

In 1846 the legislature authorized Boston to take, hold and convey to, into and through said city the water of Long Pond, so called (now Lake Cochituate), in the towns of Natick, Wayland and Framingham, and the waters which may flow into and from the same, and any other ponds and streams within the distance of four miles from said Long Pond, and any water rights connected therewith.

The decision, somewhat abbreviated, is as follows:

The city of Boston was authorized by Section 1 of that statute to take the water of Long Pond, and the waters which may flow into and from the same, and any other ponds and streams within the distance of four miles from said Long Pond, and any water rights connected therewith, so far as may be necessary for the preservation and purity of the same, for the purpose of furnishing a supply of pure water for the said city of Boston. This declared purpose relates back and illustrates the extent of the authority conferred. Water-rights may be taken so far as may be necessary for the preservation and purity of the water. The words "and any water-rights connected therewith" are not limited to the immediate antecedent, namely, the "other ponds and streams" there referred to, but they also include Long Pond itself, and the waters which may flow into and from the same. It was designed to give a broad and comprehensive authority, for the purpose of furnishing a supply of pure water for the city, and to confer the power to take everything included within the meaning of the antecedent words, so far as might be necessary for the preservation and purity of the water. Section 15, imposing a penalty for wantonly or maliciously diverting the water, or any part thereof, of any of the ponds, streams or water-sources which shall be taken by the city, or corrupting the same, rendering it impure, confirms this view. Under this authority, the city might lawfully take any water-rights connected with the waters flowing into Long Pond, including the prescriptive rights which the plaintiff contends that he then had to discharge sewage into Pegan Brook. It appears that this brook is and always has been a feeder of Long Pond; and that the whole of it is within four miles of the pond. A prescriptive right to foul the waters of a stream is included under the term "water-rights." This, indeed, is asserted by the defendant in his answer. It is a right in respect to the water of the stream; and the statute conferred power to take all water-rights which might interfere with the purity of the waters taken. It is contended for the defendant that, if it was necessary to preserve the brook or the purity of the water, power was granted to the city to take the land on each side of the brook, and thus cut off any use either of it or of its waters, and, indeed, that the water-rights could not be taken separately from the land. But it does not appear to us to be necessary, even if it was competent, for the city to take the land on the sides of the brook in order to extinguish any prescriptive right to foul the water of it.

Assuming that the defendant had such prescriptive right, it is further contended that the city did not take it, but that the taking of the waters of the brooks and streams entering into Long Pond only appropriated the water as it flowed into the pond at the time of the taking, and subject to all legal burdens and uses then existing. This, however, is too narrow a construction of the description of what was taken. The city, after reciting the whole of the first section of the statutes, took all the waters of Long Pond "and other brooks and streams, whether permanent or temporary, entering into the same," "and all the water-rights thereunto belonging or in any wise appertaining, for the sole use and benefit of said city." This language does not exactly follow the language of the statute; but we cannot doubt that it is broad enough to include Pegan Brook, and the taking of "all water-rights thereunto belonging or in any wise appertaining," includes any right then existing to foul its waters. It is urged, by way of illustration, that, if a mill existed on the brook, the right to use the mill was not taken. But it is not necessary to consider that question here. It does not appear that there was any mill on the brook. If there was, the use of the water for turning its wheels might not foul the water, and might therefore be consistent with the purposes and rights of the city. But the right to use the brook as a discharge for sewage in large quantities, as practiced by the defendant, is inconsistent with such purpose. If, therefore, the defendant had any such prescriptive right to foul the water of Pegan Brook, as he claimed, such right was taken and extinguished by the act of the city under the Statute of 1846; and by Section 6 of that act the city was liable to pay all damages sustained thereby. The defendant, if he sustained damage, might have applied by petition for the assessment thereof at any time within three years from such taking. This remedy was the exclusive one.

It was not seriously contended in the argument that the defendant has acquired a prescriptive right to foul the waters since the taking by the city in 1846. Such prescriptive right could not be acquired, because the fouling of the water, since the right to foul it ceased, would be a public nuisance. (Morton vs. Moore, 15 Gray, 576. Brookline vs. Mackintosh, 133 Mass., 125, 226.)

Finally, it was contended for the defendant that, by reason of constructions erected by the city at the mouth of the brook, since the taking in 1846, the waters of Pegan Brook do not, in fact, contaminate the water of the pond, and that, therefore, the city is not injured. It appears, however, as a fact, that the water of the brook is contaminated by the acts of the defendant. The city has a right to be protected against the necessity of maintaining works for the preservation of the purity of the water from such a cause. If the acts of the defendant in fouling the stream have made it necessary for the city to resort to extraordinary means for preserving the purity of the water of the pond, he cannot justify the continuance of such illegal fouling by showing that the city has thus far been able, by the maintenance of special works, to prevent the natural result of his acts.

The result is that the petition for an injunction is maintained.

Since this decision was rendered the Boston Water Board and its agents have entered on a systematic campaign for stopping the pollution of its water supply, compelling individuals to find some other means of disposing of their wastes than discharging them into streams conveniently near. Probably the pressure thus brought to bear upon individuals has hastened the adoption of sewerage systems in some of the towns in the drainage area of the Boston water supply. As no town or city in Massachusetts can now construct a sewerage system without the approval of the State Board of Health of its plan for disposal, and as the Boston Water Board has offered to help pay for sewage purification plants whenever these towns would put them in, we find, as has been stated, that first South Framingham and then Marlboro constructed well designed sewage purification plants, while Westboro is now building such a plant and Natick is taking steps in that direction.

The relation of the towns named to the Sudbury and Cochituate gathering areas of Boston's water supply can be seen by referring to the accompanying map, Fig. 1.

The total population of each "town" or township wholly or partially included in the drainage area are given on the map. These populations include both the village and rural inhabitants, and, as is evident from the map, are not all on the drainage areas, Northborough, for instance, having only a small part of its area coincident with the drainage area in question. But while the "towns" of Marlboro, Framingham and Natick are largely outside this area, their more densely inhabited portions are within it.

FIG. 1 TOWNSHIPS ON DRAINAGE AREAS FROM WHICH BOSTON'S WATER SUPPLY IS DERIVED.

(Populations are for whole townships, whether in drainage area or not.)

The sewage of South Framingham and Marlboro has been entirely removed from the feeders of the Sudbury River, as that of Westboro will also be. The total population of these towns is about 28,000, and the principal villages within their limits are also in the Boston water supply area.

Already, according to the reports of the officials of the Boston water-works, there is a marked improvement in the character of the water supply from this area. When Natick, whose sewage with more or less directness, contaminates Pegan Brook, tributary to Lake Cochituate, constructs a sewerage system which removes its sewage, and when Southboro takes a similar step all the grosser impurities will be removed from this drainage area.

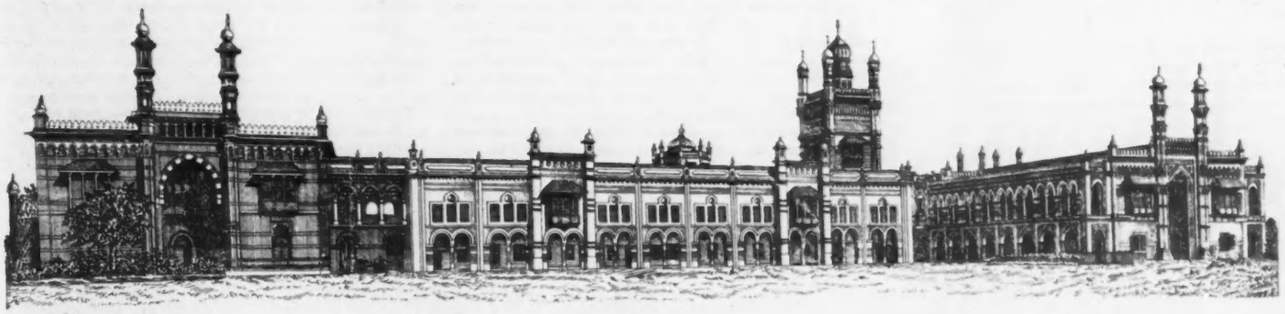
The State Board of Health and the Boston Water Board obtained the passage by the 1890 legislature of a law whereby the State Board of Health has authority to prohibit the depositing of manure, excrement, garbage, sewage or any other polluting matter within 100 ft. of the high water mark of any stream or body of water used as a source of water supply. Massachusetts is now and for some time, if not always, has been far in advance of any other state in the Union in its sanitary regulations of water supply and sewerage systems.

Descriptions of the South Framingham, Marlboro and Westboro plants will be given in later issues.

The contract for the new timber dry-dock, at the Brooklyn Navy Yard, the bids for which we gave last week, has been awarded to John Gillies, of New York, N. Y., the lowest bidder, at $412,000.

ENGINEERING SCHOOLS IN INDIA.

There are four official engineering schools in India, having buildings which have cost about $450,000 (in silver values), and expenditures of about $183,000 yearly. Their function is the training of natives for subordinate engineering positions. As an average of the last five years, 9 "assistant or apprentice engineers" and 40 "upper subordinates" have been graduated yearly from all four of these colleges together. None of the colleges show much tendency to increase in importance, as is natural from the fact that the main employment for engineers is in the government service. The four colleges in order of total expenditures (silver values) are Rurki Engineering College, N. W. Provinces, ($69,300); Poona College of Science, Bombay, ($44,800); Seebpore College, Bengal, ($44,300), and Madras Engineering College and Surveying Schools, ($26,700). As we understand it, the natives never rise into responsible engineering positions, though they show much capacity for the routine of lower positions. Whether this is from natural incapacity or from lack of opportunity and permission, we do not know.



COLLEGE OF ENGINEERING, MADRAS, INDIA.

The College of Engineering, Madras, whose handsome building is shown in the accompanying view, reproduced from "Indian Engineering," is, perhaps, the oldest educational establishment in Madras. Springing from a survey school, founded nearly a century ago, it was denominated the "Civil Engineering College" in 1859, and was affiliated to the Madras University in 1877, but there is no record to account for its present designation as the "College of Engineering." The older portion of the existing College was originally the palace of the Nawab of the Carnatic, at Chepak, on the South Beach, Madras, more generally known as the "Kalsamahal," or domed palace; the central tower was an after addition. When the adjoining Board of Revenue buildings to the right or north were being remodeled by the genius of Chisholm, the same architect also drew up the plans for the extension of the original building to the south. This handsome addition is in keeping with the rest of the Chepak buildings, which are all in the Indo-Saracenic style of architecture, and certainly form a most effective group when viewed from the far-famed Marina of Madras. The sea face of the college is over 300 ft. in length, and it is the most commodious building of its class in India.

QUALIFICATIONS FOR GOVERNMENT LAND SURVEYORS IN CAPE COLONY, SOUTH AFRICA.

The preliminary examination for the admittance of candidates into the profession of "sworn land surveyors" (fee £15) is held annually in June by the Cape of Good Hope University, and is purely theoretical. It embraces the following subjects: Arithmetic, algebra, including the binomial theorem; geometry (the first four, the sixth, and propositions 1 to 21 inclusive of the eleventh books of Euclid); plane and spherical trigonometry, including the exponential theorem and some expansions derived from it; co-ordinate geometry of the straight line, and spherical astronomy and geodesy, so far as these two subjects can be treated with the above specified mathematics. The second examination—the final—that in the practice of land surveying, is held free of charge once a year, in February, in the Surveyor-General's Office, Cape Town, and embraces:

A. Drawing; including topographical, copying plans, and drawing from model. Neatness as well as accuracy in this branch is essential.

B. The practical application of the theory of land surveying to (1) the use and adjustment of all surveying instruments; (2) determination of latitude and longitude from data; (3) co-ordinates and their practical application to land surveying; (4) overcoming difficulties in the field, such as the observation of angles, the vertices of which are inaccessible, and reduction of observations when the positions of the observed signals contain small known errors; (5) resurvey and subdivision of private property and construction of plans and diagrams according to the regulations in force; (6) construction of maps on the principle of projection on the developed surface of a cone.

C. Trial survey. In this branch candidates are required: (1) To measure correctly a base line. (2) To determine the coordinates of a number of points defined in the field. (3) To fix in the field the positions of points the coordinates of which are known. (4) To plot a plan of their survey and lay down the topography within their limits. (5) To determine by astronomical observations the direction of the true meridian with reference to points marked in the field, to find the variation of the compass, and the latitude and longitude of any given points by observation.

Sixty per cent. of the aggregate number of marks must be obtained by candidates to pass.

Before being appointed as government land surveyors candidates have to pass a surety bond for £400, and to furnish certificates signed by two competent persons to the effect that they possess the moral qualifications for the necessary conscientious fulfillment of their duties as government surveyors. A license of £5 must be taken out before surveyors are authorized to practice as such.

In practice the positions of all monuments, or "beacons," are referred to two arbitrary rectangular x and y axes; all angles are recorded to the nearest 10″, and measurements taken in "Cape measure."

The ratio of the Cape lineal foot to the British Imperial foot was investigated by the Land-measure Commissioners, appointed by the governor June 19, 1858. They ascertained that 1,000 Cape feet = 1,033 British imperial feet, and as 12 Cape feet = 1 Cape rood, 1 English mile = 425,944 Cape roods, 144 Cape square feet = 1 Cape square rood; 600 sq. roods = 1 morgen; 1 Cape morgen = 2.11654 acres, ∴ 1 acre = 0.47247 morgen (nearly).

The origin of these curious fractional differences from the British standard measures we do not know. We are indebted to a Cape Colony subscriber for the above information, which appears to indicate that the position of a colonial land surveyor is tied about with a good deal of red tape, which we manage to dispense with very comfortably. Measuring angles to 10″ in a country where land is worth no more than at the Cape of Good Hope must make surveying work pretty expensive, one would think, but as to the actual cost we have no information.

PRIVATE CAR SERVICE; WAGNER PALACE CAR CO.

There is in this country a quite considerable tourist and special traffic carried over the railways in special cars, chartered by tourist and theatrical parties, etc., which traffic is controlled by the palace car companies. From a handsome publication recently issued by the Wagner Palace Car Co., of New York, and noted in another column, we take the following particulars in regard to the chartered or special car service. This company has for charter sleeping, hotel, dining, private and tourist cars, for the use of special or family parties, tourists, theatrical companies, etc., and can also, if desired, furnish for large parties special trains complete, consisting of dining, sleeping and drawing-room cars, compartment cars, and combined baggage and buffet smoking cars, containing bath-room, barber shop, library, etc., the whole in charge of trained and skillful servants and attendants.

The sleeping cars are of different plans, having from 20 to 32 double berths, with state room, smoking room, etc., and a capacity of 20 to 60 persons. Hotel cars are of practically the same capacity as sleeping cars, with the addition of a kitchen furnished complete, with necessary equipment for serving meals during the journey. The private cars are of different designs, combine the latest improvements for the convenience and comfort of passengers, and are equipped with the most approved appliances for insuring safety. They have been specially designed with a view to supplying to parties on extended trips the conveniences and comforts of a first-class hotel. They have large saloons or parlors, furnished with movable chairs and couches, center extension table, writing desk, reading lamps, and everything requisite to make a long trip as free as possible from discomfort. The staterooms have large beds, stationary toilet stands and closets and drawers for clothing. The kitchens have every facility for furnishing meals to the number of the full capacity of the car, and are fully equipped with cooking utensils, china, silver, table ware, table linen, etc. The observation room, at the opposite end from the kitchen, has large plate glass windows. The commissariat is furnished by the company when desired, together with trained servants. The tourist cars have the same average capacity as the first-class sleeping cars, and are fully supplied with bedding and linen. The plans of some of these cars have been given in our issues of Oct. 10, 1891, and June 16, 1892.

Mr. W. S. Webb, president of the company, made a trip of 11,192 miles in a special train, as described in his book on "Alaska and California." The train consisted of four cars. The first was a combination car, with baggage compartment, sleeping compartment for the cooks and porters, a bathroom, and a smoking room or drawing-room containing a piano, desk, library, and hunting and sporting requirements. Next was a dining car, with an ordinary center table and side tables, the same as in a house. Then came a car for the ladies, children and maids, and then the private car "Ellsmere." The car "Ellsmere" is 78 ft. 11½ ins. long over all, 10 ft. 0½ ins. wide, 14 ft. 3 ins. high from rail to top of monitor roof. It contains two staterooms, with double berths, and separate toilet rooms; an observation room; toilet and bath-room; a family room 11 ft. 6 ins. by 6 ft. 9½ ins., and a main parlor or dining room 18 ft. long, with an extension table that will seat 12 persons. There is also accommodation for the car porter. The observation room is finished in quartered oak, and the pantry, etc., in black walnut.

MUNICIPAL OWNERSHIP OF STREET RAILWAYS.

In the city of Glasgow, Scotland, as well as in several other European cities, the street railways are owned by the city, and leased to an operating company under conditions designed to protect the

public's and the city's rights. According to an article in the "Street Railway Gazette," of Chicago, the street railway service of Glasgow will, by the expiration of the lease, come into the hands of the municipal authorities in July, 1894, and when this transfer of control takes place the municipality proposes to run the street railway system on its own account. The article proceeds as follows:

In Huddersfield, England, a large manufacturing city, the street railways are run by the municipality. One method adopted in Huddersfield by the municipal management can hardly fail to attract the attention of railway employees in this country; this is the method change made in the hours of work. When the municipal government first took charge of the road the hours of work for those in the service were 12 hours out of 24, but the municipality concluded to change this and adopt the 8-hour system, and for this purpose they established two shifts of employees. The system is said now to give great satisfaction, and the management, by means of it, is enabled to run its cars much more frequently early in the morning and late at night.

THE SHONE SYSTEM OF SEWERAGE.

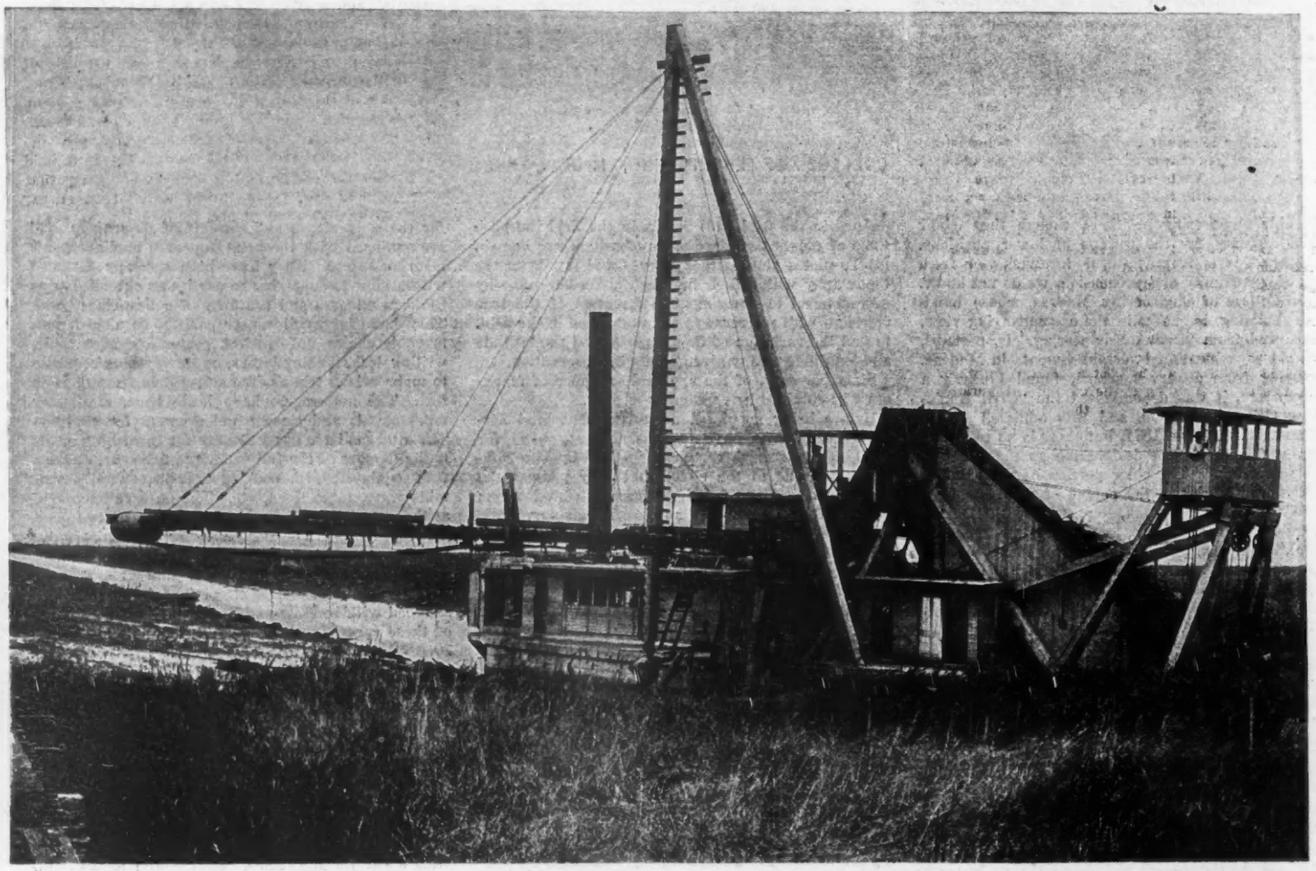
In the Shone system of sewerage and drainage the district to be covered is divided into separate drainage areas, and at the lowest point of each is located an ejector station at which all the sewage mains of that area are centered. In the ejector station is an automatic ejector, and as fast as this is filled the sewage is forced by compressed air, automatically admitted, into a sealed iron main through which it is conveyed rapidly under pressure to the outfall, or into a high level gravitation sewer. The compressed air is generated at a central station and conveyed to the ejector stations by small iron pipes. The system is in use at several places in England for the drainage of cities and buildings. It is to be used for the buildings of the World's Columbian Exposition, as noted in our issues of Jan. 16 and March 26, and for this work the contract has been let to the Shone Hydro-Pneumatic Sewerage & Water Supply Co., of Chicago, of which Mr. U. H. Broughton is engineer and manager. The above is a general description of the Shone system, and following we give an abstract of a paper read by Mr. Isaac Shone before a meeting of the Municipal and County Engineers, at Peterborough, England, referring to the special features and advantages of the system:

By the aid of this system house drains and sewers can be laid in low-lying, flat and tide-locked habitable areas, on the most perfect hygienic principles which it is possible or necessary for the practical sanitary engineer to carry out. Not only can drains and sewers be laid down by hydraulic and sanitary rules in low-lying, flat town areas, but they can also be laid, by the aid of the system, in undulating town areas, in an endless variety of ways. A few engineers in the past treated the Shone system as if its object was simply to lift sewage in opposition to the most economical pumps extant, and accordingly these gentlemen entered into elaborate calculations to try to prove that lifting sewage by compressed air was less efficient than lifting it by steam power direct in the ordinary way. The discussions which have arisen from time to time between its advocates and opponents have greatly helped to elucidate the intrinsic merits of the system, and the objections have disappeared before the indisputable evidences which have been afforded from time to time by the numerous and various works carried out on the system.

The primary object aimed at with the Shone system is to get as high a degree of sanitary efficiency in connection with the everyday working of house drains and sewers as is possible. The question which relates to the difference between the cost of lifting water by steam pumps and ejectors worked by compressed air is one of secondary importance. The ejector system may in certain cases involve the purchase of a little more fuel per annum than a steam pump, but, on the other hand, comparatively large and deeply laid sewers, discharging into one steam pumping station, would be more costly initially and annually, and they would involve a larger number of sewage-gas nuisances, and a larger number of preventable deaths, than would obtain by dividing a town or district into a number of separate automatic drainage districts on the Shone system.

The only effectual way to place house drains and sewers in a satisfactory sanitary condition is to cause them to be self-cleansing and to be properly ventilated. In order to render drains and sewers, carrying sewage only, self-cleansing, they ought to be adjusted in size and inclination to suit the volume of sewage which they are intended to carry, so that the velocity of the sewage when the period of a maximum flow obtains shall be, if possible, 2.5 ft., but never less than 2 ft., per second. If we call the 2.5 ft. 100%, then 2 ft. would only be 80%, and no drains or sewers should be designed or carried out which would permit of the velocity efficiency being less than 80% of the 2.5 ft. per second, which is the velocity now universally considered to be necessary to render drains and sewers self-cleansing. Drains and sewers thus designed, if they are also efficiently flushed and ventilated, will be perfect from a sanitary point of view, but if not thus designed they will become drains and sewers of deposit, and consequently unsanitary.

The velocity of 2.5 ft. per second, however, applies only when drains and sewers are used for the carrying of a sewage proper, on what is called the "separate system." When drains and sewers are used as the carriers of sewage and rainfall, on what is called the "combined system," a greater velocity than 2.5 ft. per second must be insured, to preserve them in a self-cleansing condition; because the rainfall carries with it road detritus, and this adheres more or less tenaciously to the drains and sewers, and by degrees consolidates on their inverts, rendering the process of self-cleansing impossible, even by the most systematic and liberal use of flushing water.



DREDGE FILLING TRESTLE AT LAKE PONTCHARTRAIN, N. O. & N. W. R. R.; Bucyrus Steam Shovel & Dredge Co., Builders.

The author then gave tables of grades of sewers for both systems which we summarize below. The column for the combined system is taken from the book on "Sewers and Drains of Populous Cities," by Col. Julius W. Adams, of Brooklyn, N. Y., and rep-

	Grades.	
Diam. of sewer.	Combined system.	Separate system.
6 ins.	1 in 60	1 in 150
9 ins.	1 in 90	1 in 248
12 ins.	1 in 200	1 in 350
15 ins.	1 in 250	1 in 458
18 ins.	1 in 300	1 in 570
24 ins.	1 in 400	1 in 805
36 ins.	1 in 600	1 in 1,300
42 ins.	1 in 700	1 in 1,575
48 ins.	1 in 800	1 in 1,849

resents the grades which will preserve circular sewers from deposit provided they run half full. The column for the separate system is taken from Mr. Shone's hydraulic tables and shows the grades at which the sewers may be laid to insure a velocity of 2½ ft. per second.

Mr. Shone then proceeds as follows:

Mr. Adams' practical experience tells him that a sewer which is used for both sewage and rainfall, even in comparatively well-scavenged towns, must have a grade which shall be sufficient to give a velocity, when the sewer is half full, equal to about 3.75 ft. per second, which is 50% more than I consider necessary to render separate sewers self cleansing. The foregoing comparison shows that the difficulties in the way of an engineer draining a low-lying, flat town of any extent, of its sewage and rainfall discharges combined in one set of drains and sewers, to one outfall or pumping station so that the drains and sewers may be maintained in a self-cleansing, and consequently sanitary condition are physically insuperable as a reasonable permissible cost. Equally insuperable would be the difficulties, if he had to drain such a town on the separate system, were the whole of the sewage conducted to one outfall or pumping station.

I have long advocated the adoption of the separate system in preference to the combined system in all new drainage projects, providing, of course, that the works are carried out on sound sanitary principles, and providing the drainage of the sewage proper cannot be conducted, say, to a sea outfall, through drains and sewers which will carry the sewage, separately or in combination with the rainfall, at a perfectly satisfactory self cleansing velocity. Some engineers have said that all sanitary engineers nowadays lay down sewers at grades which will secure "self-cleansing" velocities, but many engineers call sewers designed by them self-cleansing sewers if they are laid at grades suitable to their size, regardless of the volume of sewage available to them. Engineers, for example, have advised sanitary authorities to the effect that a 24-in. sewer laid at a gradient of 1 in 805 was laid at a self-cleansing gradient, which was literally true, if only the volume of sewage estimated to be available to the sewer has been sufficient to half fill it; but, inasmuch as the sewage available was barely sufficient to half fill a 6-in. pipe laid at a gradient of 1 in 150, the velocity of that volume of sewage flowing on the invert of the 24-in. sewer would not exceed 1.16 ft. per second; giving only 46% efficiency. In this case, as in many others, the engineer laid the sewer at the best inclination at which he was able to lay it owing to the natural configuration of the ground. It is in this way that the so-called English water carriage system of sewage removal from houses and towns, has wrought so much unsanitary mischief all the world over.

A 24-in. sewer pipe is 16 times more capacious than a 6-in. pipe, and consequently, all things being equal, it will hold 16 times more foul air, and it will require 16 times more water to flush it than would be required to flush the 6-in. sewer. Moreover, the 24-in. sewer would cost, roughly, five times more than the 6-in. sewer. These statements tend to show that we ought in all cases reasonably possible to recommend the adoption of the separate system of town drainage. Again, the cost of treating sewage conducted to the outfall on the separate system is reduced to a minimum. The value of sewage discharged on the Shone system, where the separate system of drainage is adopted in connection with it, if it is utilized as liquid manure upon land suitable for irrigation purposes, must necessarily be much greater than it can be when it is discharged into drains and sewers on the combined system.

A town or district as flat as a pancake can be subdivided into as many sections as may be necessary to insure (1), the essential grades, being always obtained for the smallest permissible pipe sewers and (2) to avoid deep and costly trenching for the gravitation sewers and ejector stations. By adopting this plan of drainage small pipes of short lengths only are required, and these at the lowest points—viz.: at the ejector stations—need not exceed 14 ft. on the average in depth. In this way a flat surface built over, and containing about 40 acres, could be absolutely sanitarily drained by one ejector station. If this area were not inhabited at the rate of 50 persons per acre, then the sewage of a population of 2,000 would flow to the ejector station. Again, if this population discharged sewage and rainfall combined into the sewers equal to 30 gallons per head per day, then, according to the author's rule of determining the maximum quantity of sewage which would have to be ejected at such a station, the volume would be equal to

$$\left(\frac{2{,}000 \times 30 \div 2}{460} = \right) 75 \text{ gallons per minute.}$$

For this quantity there should be two ejectors, each of 100 gallons capacity. The ejectors and station complete would cost about $2,250. If the lift and friction combined equaled, say, 60 ft., then 75 gallons per minute of compressed air, at a pressure of 26 lbs. per sq. in. above the atmosphere, must be supplied to the ejectors to work them. This would require an engine to indicate 3.4 HP. If this station were one of many, then the coal consumption would not exceed 3 lbs. per I. HP. per hour, and for 14 hours' working this would mean a coal consumption of 145 lbs. per day. The cost of attendance at such a station would be inappreciable. Indeed, the cost that would be necessary to incur for attending to purely gravitation drainage works would not be exceeded by the cost that the ejector attendance would involve.

The following towns have applied the Shone system more or less in its entirety: Henley-on-Thames and Beaumaris (at these places automatic flush tanks and the author's new system of ventilating sewers were not used), Rangoon, Hampton Wick, and Wallingford. The improved system of ventilating sewers was not applied at Rangoon, for the reason that it was not invented at the time when those works were designed. But at Wallingford is to be found the most complete example of drainage works on the Shone system. There the public sewers have automatic flush tanks and air inlets at their heads, and there also all the manhole covers are sealed, and the nozzle sewer ventilators are connected with each ejector station. Nuisances arise from perforated manhole covers over street sewers, and these nuisances are intensified when house connections are being formed with new drainage works. At Wallingford, however, such nuisances have been rendered non-existent; not a single case of complaint having been made up to the present time. The sanitary authorities of Eastbourne, Llanfairfechan, Hastings and Felixstone have adopted the system, and the World's Columbian Exposition, at Chicago, is also to be drained on this system (Eng. News, Jan. 16, and March 26).

Objections are occasionally raised to the system on the score of first cost. The following statement, which may be relied upon, will, however, serve to show that even in point of first cost the Shone system is to be preferred to the ordinary gravitation drainage. For example, the following towns were drained on the ordinary system: Margate (where hydraulic pumping is resorted to), Southport, and Llandudno, and the cost per head amounted to an average of $29. At the following places, drained on the Shone system, the approximate cost per head has been as follows:

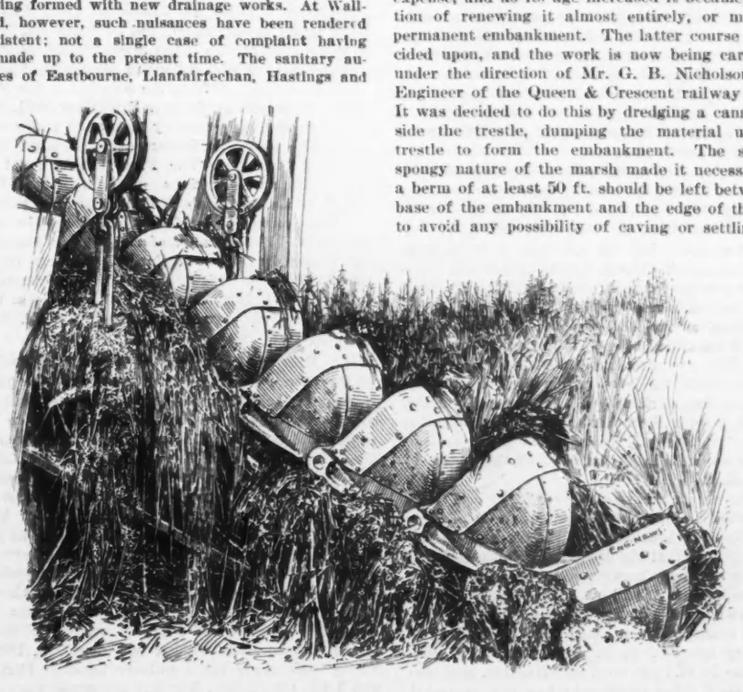
Beaumaris	$15
Henley-on-Thames	19
Wallingford	17
Hampton Wick	17
Average	17
Rangoon (India)	11

These costs show that high-class sanitary drainage works on the Shone system may be carried out at home and abroad at fairly low prices per head of the population. In point of fact, the author knows cases where the ordinary gravitation plan has been carried out at prices which are more than double those at which the same extent of sewerage work could have been carried out on the Shone system.

DREDGE FOR TRESTLE-FILLING ON THE NEW ORLEANS & NORTHEASTERN R. R.

The filling in of timber trestles to form a solid bank is a class of work with which many railways have to deal from time to time. The trestles are built in the first place on account of rapidity of construction and cheapness as compared with an embankment, but when they are weakened by the decay of the timbers it is more economical and better practice to fill in a solid bank, sufficient water-way capacity being provided for by culverts where necessary. The work is generally performed by dumping material from dirt trains run onto the trestle, but we give below an interesting account of the use of a steam dredge for excavating material from a swamp and dumping it along a trestle to form a bank.

On the line of the New Orleans & Northeastern R. R., just outside the city of New Orleans, La., there is a trestle some 18 miles in length, 13 miles of which skirts the shore of Lake Pontchartrain, keeping a little distance in upon the salt marsh, and five miles is creosoted trestle across the end of the lake in open water where it extends through the Rigolets into the waters of Mississippi Sound. The trestle is 7 ft. high above the marsh, and rises to 10 ft. above the water where it crosses the lake. The maintenance of this trestle has always been a heavy expense, and as its age increased it became a question of renewing it almost entirely, or making a permanent embankment. The latter course was decided upon, and the work is now being carried out under the direction of Mr. G. B. Nicholson, Chief Engineer of the Queen & Crescent railway system. It was decided to do this by dredging a canal alongside the trestle, dumping the material upon the trestle to form the embankment. The soft and spongy nature of the marsh made it necessary that a berm of at least 50 ft. should be left between the base of the embankment and the edge of the canal, to avoid any possibility of caving or settling. For the same reason it was desirable to make the section of the canal wide and shallow, rather than narrow and deep.



VIEW OF BUCKETS OF DREDGE AT WORK IN THE MARSH AT LAKE PONTCHARTRAIN.

To fulfill these conditions it was decided to adopt the dredge, of which we give an illustration, of the elevator type, with a belt conveyer 90 ft. long, for carrying off the material and depositing it upon the trestle. This dredge was built by the Bucyrus Steam Shovel & Dredge Co., of Bucyrus, O., from the designs of its engineer, Mr. A. W. Robinson, and has proved to be a very successful machine and well adapted to the work. The monthly performance of the dredge is shown in the table on the following page. The volume of excavation was measured in place; that is, the product of the lineal advance into the section of the cut, measured after the dredge had passed. The working time was about 7 hours per day:

The section of the cut was 6 ft. deep by 60 ft. wide, uniform throughout. The short progress made in some months was due to the fact that many sunken logs and cypress roots were encountered, and part of the distance was through cypress swamp. It may be supposed that this type of dredge is not well adapted for such work, and, of course, more

rapid progress was made in open prairie than in cypress swamp; but the only result was diminution in speed, the dredge being strong and powerful enough to bring up the logs on the buckets when

Month ending	Lin. ft. advance.	Cu. yds.
Jan. 1 to Feb. 28, 1891	4,530	74,000
March 31	2,100	29,000
April 30	2,260	31,800
May 31	1,860	25,333
June 30	1,900	25,333
July 31	2,155	28,733
August 31	3,460	46,133
September 30	2,135	28,467
October 31	2,420	32,267
November 30	1,880	25,067
December 31	1,800	23,867
January 31, 1892	1,500	20,667
February 29	2,915	38,867
March 31	1,435	19,133
April 30	1,820	24,267
Total	34,170	472,934
Average	2,135	29,558

they were lifted or floated off. It will be seen from the table that the average output of the dredge was 1,180 cu. yds. per day for the whole time, and for the best month, when there were no serious delays from the cypress, 1,770 cu. yds. per day. The working time was about seven hours, the remaining three working hours of the day being occupied in clearing the track and waiting for passage of trains. If the dredge had worked the usual ten hours at the same rate the monthly average above quoted would be increased from 1,770 cu. yds. per day to 2,528 cu. yds., and if the measurement had been in scows, as dredging is frequently measured, the best monthly average would be 3,500 cu. yds. per day of ten hours. The company owning the dredge ordered a duplicate of it for the same work, and the second one has been put in operation.

The dredge hull is 40 ft. wide, 40 ft. long and 6 ft. deep, and is divided into ten compartments by four intersecting bulkheads. Two of the bulkheads are transverse and form a base upon which the A-frames, for supporting the conveyer with its back guys, are mounted. The dredge is held and fed into the cut by two spuds, one near the center of the boat and upon which it revolves, and another walking or stepping spud at the stern, by which the dredge is forced and fed ahead at each lateral traverse of the buckets. The swinging movement is obtained by side-chains from the bow running out to anchorages. These are worked by a small pair of engines, and together with the other motions are controlled from the "pilot-house," from which point the operator can see and direct the work of the dredge to good advantage.

The motions of the spuds are all performed by power in such a way that the feed of the buckets is uniform for the whole width of the cut and the advance definite, so that the dredging is continuous and no stoppage or empty buckets occur because of moving up. The buckets are 26 ins. pitch, 4 cu. ft. capacity each, and are fitted with Robinson's patent protected and lubricated joint connections. They run at the ordinary speed of 40 ft. per minute. The conveyer frame is of light steel construction, and the rollers of steel tubes running in bearings protected from dirt. The conveyer belt was estimated to last one year in steady work, but the original belt is still in service after having conveyed nearly half a million cu. yds. of material. The original bucket-pins and conveyer roller-bearings are also in use. The cost of excavation by this dredge is about 3 cts. per cu. yd., and a crew of six men is required to run it.

The engineering staff of the Chicago Drainage Board is already made up. According to a recent statement by Mr. Cooley, one of the trustees, the engineering committee has all the men it will want. There are 91 men in the construction department now, and that number is sufficient for all requirements. Permanent engineering residences will be established at Romeo, Lemont, Sag, and Willow Springs. Each of them will be in charge of an assistant engineer, with eight capable assistants under him, and a force of laborers sufficient for his work. It will be his duty to lay out the lines for the contractors and keep an eye on the excavations, to see that the specifications are not slighted.

American railway material is finding its way into the British colonies, and a large order for the Greer track spike has been received by Morris Sellers & Co., of Chicago, from the New Zealand Government Railways. This spike was described and illustrated in our issue of March 19.

EARLY RAILWAYS BETWEEN NEW ENGLAND AND CANADA.

Railway communication between Canada and the Atlantic coast was suggested nearly 50 years ago, when railways were beginning to be recognized as a coming power in the development of the United States, and the first proposition for a railway from Montreal, Que., to Portland, Me., and then eastward to St. John, N. B., and Halifax, N. S., was made in 1843, by Mr. John Alfred Poor, of Portland, who became one of the leading men in promoting railway enterprises in New England. Mr. Poor recognized the advantages of a railway between the upper and lower provinces of Canada, traversing the state of Maine, and advocated the construction of a line for its international importance as shortening the time between Great Britain and the North American continent by establishing an eastern port. Mainly through this enterprise the railway was built by which the Grand Trunk Ry. now runs from Montreal to Portland, as well as the eastward line from Portland to St. John and Halifax, above referred to. Mr. Poor was born in Jan. 1808, at East Andover, Me. He studied law, was admitted to the bar in 1832, and started a practice at Oldtown, twelve miles from Bangor. He was enthusiastic and energetic in advancing the interests of his native state, but it is with his work in railway enterprises that we are concerned here. His ideas were large, but practical, and 50 years ago he foresaw the construction of an international railway between Canadian and American ports, and of a transcontinental railway from the Atlantic to the Pacific. Up to the time of his death in September, 1871, he was actively engaged in railway promotion and construction. The above particulars are abstracted from a recent publication, "The First International Railway—Life and Writings of John Alfred Poor," edited by Laura Elizabeth Poor, and from this book we have compiled the following description of the growth and development of railways in Maine and the Lower Provinces of Canada. It may be mentioned that in 1849 Mr. Poor purchased the "American Railway Journal," of New York, which was afterward owned and edited by Mr. Henry Varnum Poor.

Mr. Poor was present at Boston on April 16, 1834, when the first locomotive engine, with passenger cars attached, ran over a railway just built from Boston to Newton, and afterward extended to Worcester and beyond. This is said to have given him the idea of the great future of railways which led him to devote so much time to promoting and encouraging their construction. In 1836 the first railway operated by locomotives in the state of Maine was built between Bangor and Oldtown. The legislature adopted measures which led to the survey of several routes for a railway between the seaboard of Maine and the St. Lawrence River, in Canada. The shortest and most practicable route was from Belfast to Quebec, and a report was made upon it by an engineer, but nothing was done. In 1839, a survey was made for a railway between Portland and Lake Champlain, but this enterprise also came to nothing. Mr. Poor was thoroughly acquainted with the geography of the state and its resources, and in 1843 he made public his plan for two great railways, one from Portland to Montreal, and the other from Portland to Halifax, his project being to shorten the steamship route to England. In 1884 he began to agitate for the former line by means of public meetings, memorials, etc., and he traveled over the proposed route. A company was organized, a preliminary survey completed before December, and a charter was applied for, but before it was granted it was found that agents from Boston were in Canada trying to secure aid in the construction of a road from Montreal to Boston. Before the railway to Montreal had been suggested in Portland, three lines from Boston to Montreal had been chartered. These were the Boston, Concord & Montreal R. R., chartered in 1844, acting in connection with the Passumpsic R. R., whose charter was of earlier date; the Vermont Central R. R., in connection with the Northern R. R. of New Hampshire, and the Rutland & Burlington R. R., as an extension of the Fitchburg R. R. All these had agents in Montreal before Portland, and during the whole time that the railway policy of Canada was under discussion in 1845. Mr. Poor at once went to Montreal by a sleigh in February, and after a dangerous journey arrived in time to prevent the adoption of a resolution by the Board of Trade in favor of a line to Boston. Later a race by team was made from Portland and Boston to Montreal with English mails landed at both places by the same steamer. Teams were stationed along the route, and the mail from Portland arrived twelve hours before that from Boston. This led to the adoption of the Portland line by the Canadians, and the Atlantic & St. Lawrence Ry. Co. was incorporated to build the American portion of the line. Work was commenced at Portland on July 4, 1846, and soon after the Atlantic & St. Lawrence Ry. Co. was incorporated to build the Canadian portion, and commenced work at Montreal.

The distances of the two routes were as follows:

Montreal to Sherbrooke	91	miles.
Sherbrooke to Canaan	30	"
Canaan to Colebrooke	10	"
Colebrooke to Andover	43	"
Andover to Portland	72	"
Total	246	"
Montreal to Sherbrooke	91	miles.
Sherbrooke to Stanstead	34	"
Stanstead to Haverhill	80	"
Haverhill to Concord	70	"
Concord to Boston	76	"
Total	351	"

The question of gage was a disputed one, the Chief Engineer, Mr. A. C. Morton, advocated the 5 ft. 6 ins. gage adopted by the British Government as the standard for India, while others advocated 6 ft. and 4 ft. 8½ ins. The Canadian Parliament passed a law fixing the gage of the St. Lawrence & Atlantic Ry. at 4 ft. 8½ ins., unless the Governor in Council should within six months determine upon a different gage, and Mr. Poor, with delegates from the Atlantic & St. Lawrence and St. Lawrence & Atlantic companies, succeeded in obtaining an order in council establishing the gage of 5 ft. 6 ins. In 1851 Mr. Poor successfully urged the adoption of this gage for the Great Western Ry. of Canada. His idea was to avoid such a connection as would enable the standard gage railways of Massachusetts to control the railways of Maine.

The project of a line from Portland to St. John and Halifax was now taken up, and it was proposed to use the Atlantic & St. Lawrence Ry. as far east as Lewiston, and then make an extension to Gardiner and Augusta, with a branch at Brunswick and Bath. As soon as this was proposed the Kennebec Valley people began a rival line, on the standard gage, east from Portland, in 1845. In 1846 a broad gage line, the Androscoggin & Kennebec Ry., was started eastward, from Danville Junction, under the auspices of the Atlantic & St. Lawrence, the latter assuring connection with railways leading out of Portland on the west. For this purpose Commercial St. was built, and tracks laid along it to connect the two eastern and western railways. The war of the gages was closed by the consolidation of the parallel and competing lines from Portland to Waterville, by Boston capital, with the Boston or standard gage.

In 1848 charters were applied for in New Hampshire and Vermont for the construction of the Atlantic & St. Lawrence Ry. across these states, and were granted after much opposition. In 1849 a suspension for want of money was feared, but was avoided by the plan suggested by Mr. Poor of letting the whole road as one contract and paying a high price, as the only means of saving the contractors from failure. The contract was let to Black, Wood & Co. In 1851 Mr. Poor was chosen President of the New York & Cumberland Ry., now the Portland & Rochester, and he also secured the extension of the line from Gorham to the Saco River. When the line from Portland to Halifax was suggested, a rival project from Quebec to Halifax was started and a survey was made. The lower provinces made offers of money and public lands if the home or imperial government would undertake the accomplishment of the scheme, but the British Ministry rejected the application in 1850, and the lower provinces then supported the Portland line. The city of Quebec proposed to connect with the Portland and Montreal line at Richmond, thereby obtaining connection with Montreal and Portland, and ultimately with the lower provinces. In 1850 the Maine Legislature was petitioned to authorize a survey to discover the best and most practicable route between Bangor and the New Brunswick boundary, and $5,000 was appropriated for the survey. In 1853 a

charter was granted to the European & North American Ry. Co., of Maine. Mr. Poor claimed that by means of this railway to Halifax and a steamship line to Galway, Ireland, 2,000 miles from Halifax, the transit between the two continents could be reduced to five days, and between London and New York to seven days. The Britannia tubular bridge across the Menai Straits was opened in the spring of 1850, enabling the London & Northwestern Ry. to run through trains from London to Holyhead, whence steamers crossed to Dublin in 3½ hours, and from Dublin the Midland Ry. of Ireland had been built half way to Galway.

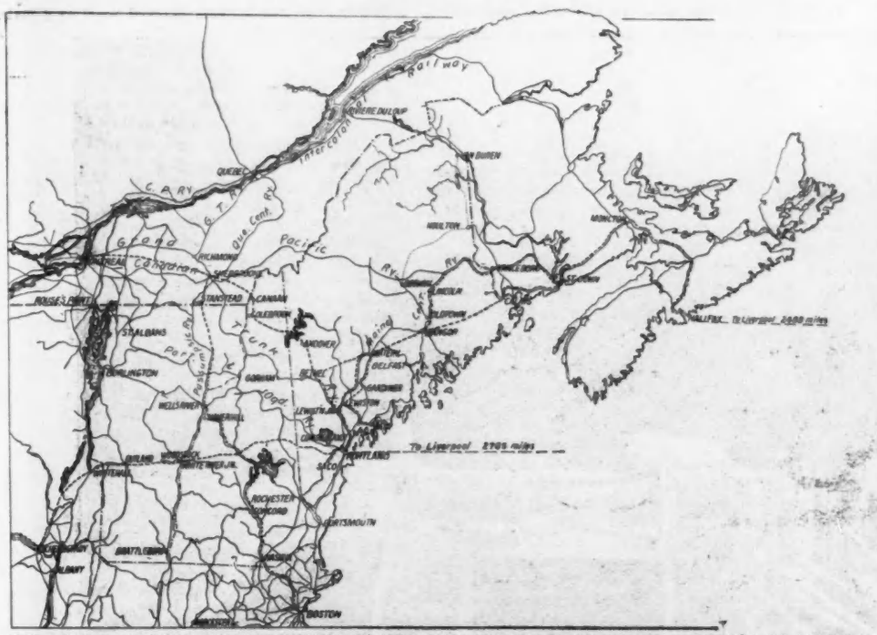
In 1851 New Brunswick granted a charter for the Portland and Halifax line, with a land grant and cash subsidy. In Nova Scotia, the Hon. Joseph Howe, of the Executive Council, had taken the ground that the railway should be a public highway, and as such should be built by the government, and he sent to England to secure an imperial guarantee to the Nova Scotia lands to be issued for this purpose. This was granted in 1851, on condition that by the co-operation of New Brunswick and Canada a connection should be secured from Halifax to Quebec through British territory. Such a line had been surveyed by the imperial government when the Portland and Montreal railway was begun, and the colonial line was the revival of the same project, three times abandoned but eventually built. The condition was too heavy, however, and Mr. Howe's mission came to nothing. He made a speech at Portland in favor of this line in 1851, and was answered by Mr. Poor, speaking for the European & North American Ry., as "international and commercial rather than intercolonial and political."

In 1852 Hon. Francis Hincks, a Canadian statesman, went to England to seek assistance from the imperial government toward building a trunk line of railway for Canada. It would extend from Quebec to Montreal by the branch from Quebec to Richmond, on the St. Lawrence & Atlantic, and from Montreal would run to Toronto. The delays of the Colonial Office disgusted him, and he made arrangements with the English firm of railway contractors, Messrs. Jackson, Brassey, Peto & Betts, for the construction of the line. Mr. Poor's suggestion for a connection between Canada and the lower provinces was adopted, the plan being to build a cut-off from Bethel to Bangor (by which Bangor would be only 30 miles farther than Portland from Montreal), and the extension by way of Calais and along the shore to St. John, N. B. The English contractors proposed to build this line from Waterville, Me., to Halifax, N. S., advancing 80% of the money, intending to bring out the entire scheme in London. The charter was refused by the Maine Legislature, and the Grand Trunk scheme was delayed for the Bangor part until April, 1883, and then brought out alone in London. Another adopted suggestion of Mr. Poor's was the lease of the line from Montreal to Portland in order to secure a winter port, the Canadian idea having been to provide only for local traffic between Montreal and Toronto, but the contractors saw the necessity of a through traffic and wished to provide for extensions at both ends. In August, 1853, this line, owned by the two companies, was formally leased to the Grand Trunk Ry. Co., and in 1856 the Grand Trunk line to Toronto was opened. The western extension has been carried out to Sarnia, Ont., and thence on American soil to Chicago, as the Chicago & Grand Trunk Ry.

In 1857-1858 Mr. Poor advocated the construction of branches of the European & North American Ry. to the Aroostook and Piscataquis counties, of Maine, and advocated also the development of the resources and water power of these districts. In 1863 the Oldtown & Lincoln, the Penobscot and the Aroostook roads were united with the European & North American. When Massachusetts was applied to in 1865 to discharge the debt due from Maine in favor of the European & North American Ry., aid was declined on the ground of a Maine law of 1860 forbidding the change of gage. Mr. Poor applied to the legislature to repeal this law, and for leave to lay a third rail on the Portland, Saco & Portsmouth Ry., with a view of extending the broad gage from Halifax to Boston and New York. The law was repealed. At this time there was much agitation in the lower provinces over the proposed confederation of all British North America, and New Brunswick strongly opposed the confederation. In 1865 Mr. Poor, in behalf of his company, proposed to complete the lines in New Brunswick and Nova Scotia for an annual subsidy of $80,000 from the two provinces, guaranteed until the lines should pay 6% of the cost. The former government declined this arrangement, but voted $10,000 a mile to complete the line from St. John westward to the boundary. Mr. Poor, as president of the Maine company, made a contract with the New Brunswick company, and then made a contract to build the entire line of the European & North American Ry. through the state and the province. Work was commenced at St. John in November, 1865, and at Bangor, Me., in 1867. In 1867 the repeated offer of the imperial government to build the Intercolonial Ry. from Halifax to Quebec, conditional upon the confederation, induced both New Brunswick and Nova Scotia to accept the confederation. The European & North American Ry. was opened in October, 1871 (some years before the opening of the Intercolonial Ry.) with a grand celebration in which the President of the United States and the Governor-General of Canada took part.

In addition to this "international" railway, Mr. Poor also projected a line to connect Portland with Chicago and ultimately with the Pacific coast, recognizing the importance of a transcontinental line of railway. In 1869 he wrote that for 30 years he had contemplated as a certainty the completion of such a line, and in 1845 he had correspondence with Mr. Asa Whitney on the subject. Mr. Whitney's and other early projects for a transcontinental railway were described in our issue of Feb. 16, 1889. Mr. Poor secured from the legislature a charter for a railway from Portland to Rutland, Vt., by way of the Ossipee valley, White River Junction and Woodstock. The route then proposed was to Whitehall, Oswego, Buffalo, Detroit and Chicago. The city of Portland, however, did not foresee the advantages of the line and opposed the plan, but favored the Portland & Ogdensburg Ry., in spite of Mr. Poor's arguments against that line, which was ultimately built, but which after taking nearly $2,000,000 from Portland, passed into the control of Boston railway men. In 1869 the Portland, Rutland, Oswego & Chicago Ry. Co. was organized, and in 1871 a bill was presented in Congress for the payment by the Treasury of $50,000 per mile, in 30-year bonds, as each section of 40 miles was built and equipped, the road to be double track, with steel rails and iron bridges. Five of six railway companies along the projected route agreed in July, 1871, to unite as one company, and the meeting was deferred until Sept. 29 owing to the delay of the other company. Mr. Poor, however, died on Sept. 5, and the project fell through. He had formed a scheme for Atlantic and Pacific steamship lines in connection with his transcontinental railway, and looked forward to through traffic between China and England under one company's management, a plan which has never been carried out in the United States, but has been carried out by the Canadian Pacific Ry. There is, however, a through train summer service now between Portland and Chicago, by way of the Portland & Ogdensburg (Maine Central), the Rome, Watertown & Ogdensburg and the Michigan Central railways.

The accompanying map shows the present railway system of New England, and, by short dash lines, the several early projected railways referred to in the article. The route of the Bangor & Aroostook Ry., the contract for which has recently been let, as noted in our issue of July 21, is shown by a dotted line.



MAP OF THE PRESENT RAILWAY SYSTEM OF NEW ENGLAND AND THE LOWER PROVINCES OF CANADA.

The dash lines indicate the early projected routes. The dotted line indicates the new Bangor & Aroostook Ry.

METER GAGE RAILWAY SYSTEM IN INDIA.

The meter gage railways of northern India are to be connected to a considerable extent to form a complete system by means of laying a third rail on some of the railways having the standard Indian gage (5 ft. 6 ins.), which connect points on the meter gage lines. This plan was proposed by Sir Edward Watkin, and was noted in our issues of Oct. 24, 1891, and May 26, 1892.

These meter gage railways, aggregating little short of 4,000 miles in length, cover the whole width of the peninsula, from eastern Bengal to the western coast of Kathiawar, a distance of about 1,300 miles, and have proved of great value as parts of the Indian railway system, paying in 1891, the largest of them, 9½% on its cost, and in all cases not less than 4 to 5%. Their utility has, however, been considerably abridged by the deliberate refusal of the Government of India to allow through connection of the various groups to be completed on the same gage. All that was required to link them up into one continuous road was the laying down, on already existing 5 ft. 6 ins. gage railways, of a third rail for about 90 miles between Cawnpore, Lucknow and Byram Ghat on the Gogra River, and about 40 miles between Viramgam and Wadhwan on the Bombay, Baroda & Central India Ry., at a cost in all of about $600,000. The inconvenience, delay and expense caused by the subsequent enforced break of bulk and transhipment of through traffic at the junctions of the two gages have been considerable, and have been for years protested against by the railway companies and the mercantile representatives interested of northern and western India, as restricting trade and intercourse in an indefensible manner.

Whether the meter gage is theoretically the best or not is now a question of minor importance. It

has shown itself in practical working equal to the performance of a very large amount of useful work, most beneficial to the districts it serves, and the value of the meter gage lines for purposes of local traffic will, by the completion now ordered, be very considerably increased, as there will be an interchange of local products between the provinces, without loss or break of bulk, greatly to the advantage of the trade of these provinces, and to their protection from famine, while 4,000 miles of railway, upon the construction of which about $100,000,000 have been expended, will practically be added to the railway system of India, regarded as a whole.

REJECTION OF BIDS FOR THE NEW CROTON DAM.

All the bids for the new Croton Dam have been rejected by the New York Aqueduct Commissioners, and new bids will be received until Aug. 24. The estimate for the cost of the dam, as made by Chief Engineer A. Fteley, was $4,574,820, or $1,047,180 above the lowest bid, which was $3,527,640. The highest bid was $5,549,998, submitted by William Russell Allen, William H. Swift, Claus Vieth and Jeremiah Fruin, of St. Louis. This bid was $975,178 above the engineer's estimate. There were two other bids below and also two others above the engineer's estimate. The grounds for rejecting the bid of the Ryan & McDonald Construction Co., of Baltimore, Md., was stated by the Construction Committee of the Aqueduct Commission as follows:

Were the contract in the firm name of Ryan & McDonald, your committee would without hesitancy advise the awarding of the contract to them. The construction company above named, however, was formed as a corporation late in the year 1891, under the laws of the state of West Virginia, with a capital of $400,000, of which sum $235,000 is in the plant, comprising the necessary machinery to construct different works and contractors' implements; the balance of $165,000 is in anticipated profits in a contract for a tunnel in the city of Baltimore, and in another contract for freight yards for the Baltimore & Ohio R. R.

Your committee has been unable to find that any cash capital has been placed in the treasury of this corporation, the stockholders of which consist principally of employees of Messrs. Ryan & McDonald, and therefore we have come to the conclusion that the only reason for forming the above corporation was to limit and evade liability.

Attention need hardly be called to the fact that the building of such a vast work as the new Croton dam, the greatest undertaking of its kind ever attempted, requires a very large capital. It is therefore of the utmost importance that the city should be amply assured of the completion of the work once begun; since the abandonment by the contractors of this work in a half-completed condition would involve the city in great loss. The capital of the Ryan & McDonald Construction Co. offers no such security, nor is there any personal liability involved on the part of its principal stockholders. On their bond for $500,000 is the American Surety Co., a corporation of undoubted responsibility, but we do not think that the right of action on a bond, however good the bondsmen may be, can compensate for the absence of responsibility on the part of the principals.

While recognizing the advantages to the city of the lowness of this bid of $3,527,640, your committee cannot but regard them as offset by the limited financial responsibility of the corporation making the bid, and that these advantages would be rendered entirely valueless by the delay occasioned by the failure to complete the work, and by the suits at law which would probably follow.

THE JUSTIN PROJECTILE FOR HIGH EXPLOSIVES.

Some very interesting experiments with the Justin projectiles for firing explosive gelatine or dynamite have recently been made at Perryville, N. Y. From an article in the "Iron Age" we abstract the following particulars in regard to the projectile and the experiments, and we are indebted to the same paper for the accompanying cuts, one of which represents the target and firing butt, while the other shows the appearance of the target after the shot. Instantaneous photographs were taken of the explosions. Details of armor plate tests conducted by the U. S. Ordnance Bureau have been given in our issue of July 18, Sept. 19 and Nov. 28, 1891, and it is said that the Ordnance Bureau will probably make some experiments with the Justin projectile.

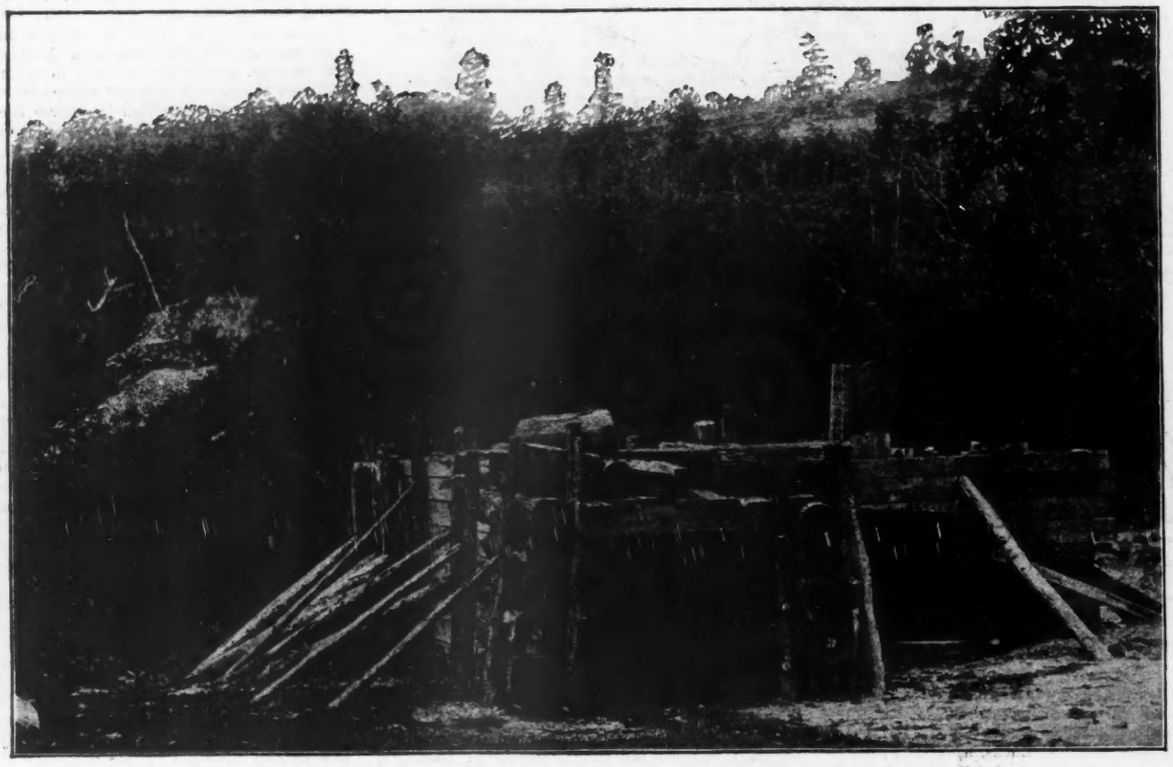


FIG. 1. FIRING BUTT USED IN TESTING THE JUSTIN PROJECTILE.

What has been thus far accomplished is to fire a mass of explosive gelatine from guns firing gunpowder charges without there being a bursting of the guns or any other accident. The experts declared only a couple of years ago that it was extremely problematical if this could be done, and they based their opinions upon the various accidents that had accompanied all previous attempts. The solution of the problem was thought to lie in the application of pneumatic power, and in the so-called Zalinski dynamite guns we find that success has been reached by that means. The shells thrown from them are, however, nothing more than aerial torpedoes, and the distance that they can travel is not great enough for the purpose in view. Within their range they are terribly effective, and have power enough to crush in a vessel's deck should they land upon it, or blow her out of the water if they fall alongside. They cannot, however, pierce armor of any thickness, nor is their flight great enough.

To overcome these difficulties and to demonstrate the fact that it is possible to fill shells with dynamite, gun cotton, gelatine, or other high explosive, and have them pierce steel plates and their backing before explosion, Dr. Justin invented a method that has scored a signal triumph and placed him in the front rank of the ordnance experts of the day. This victory has not been won without numerous failures, and those who were present upon two former occasions, when 9-in. guns were burst without there being anything of a positively satisfactory nature accomplished, were very skeptical as to their being anything in it. The trouble with former experiments was largely due to the fact of the "carrier," as it is called, being made of metal. This carrier is a shell within a shell, and contains the explosive gelatine. Its walls had to be very thin in order that it should contain a sufficient quantity of the explosive compound. This thinness was fatal, as it permitted a bending or buckling, which was enough to wedge the carrier in the shell and make the shock of discharge sufficient to cause a premature explosion. The twist imparted to the projectile by the rifling of the bore of the gun was thought to be far more dangerous to the carrier than the shock caused by the firing of the powder. To remedy this fault of a too early explosion, the inventor adopted wood as a material for the carrier instead of steel, and the change seems to have been a decided success.

The operation of loading the carrier and preparing the shell for firing occupies but a short time. Explosive gelatine was chosen because of its power. It is far more potent than gun cotton, which has been selected as the high explosive for service torpedoes, and is at the same time less sensitive. Camphor has been added to reduce the sensitiveness, while at the same time it does not detract from the explosive force.

The pasty-looking explosive is packed into the carrier by hand, the operators being obliged to wear rubber gloves to prevent a serious headache which is sure to last for at least 24 hours following a handling of the gelatine without gloves. The charge for the 9-in. shells is 94 lbs., and after this has been carefully stowed away there is just room enough to put in the primer

and close the base of the shell. The carrier is composed of three principal parts—the base, dome and body. The base is turned from a block of hard maple, made by gluing and joining 2-in. pieces of crossways of the grain. The center for the upper side is chambered to receive the lower end of the detonator, the latter being rigidly held in position by a steel pin which traverses the base and detonator at right angles to the primer. The body and dome are made of white wood. The collar, which joins the dome to the body, is turned from a block of hard maple, and is glued and doweled to the body and to the dome.

Over the wooden dome is secured a spun copper cap, bearing upon its apex a steel shaft terminating in a ball-like enlargement. Beneath the ball the shaft is transfixed by a steel pin. Upon the shoulder formed by the collar and the base are secured flanged disks of leather. One side of the body is grooved to receive the firing pin, the lower end of the g.oove being adapted to receive the upright portion of the primer. Encircling the body of the explosive carrier are six steel bands, the spaces between them increasing gradually from below upward. At the point where they cross the groove they form so many guides for the firing pin. The base is drilled through the detonator to receive the horizontal portion of the primer.

The primer consists of a tube of brass joined at a right angle by a vertical tube, and forming one piece. A horizontal tube screws into the open end of the first mentioned tube. Passing through the vertical portion of the primer is the friction pin, which is cylindrical at its upper extremity, twisted and serrated in the middle part, and contracted into a rod in the lower part. The explosive carriers are made from thoroughly seasoned stock. After being turned to the proper size, they are dipped in melted paraffine and the outer surface finished with a coat of japan. This treatment prevents shrinkage and they remain unaffected by variations of humidity and temperature. When fired from a rifled gun the shell operates as follows: A steel swage plate at the base is driven in by the expanding powder gases, forcing a copper flange into the grooves of the rifling, causing the walls of the projectile to rotate around the explosive carrier. The latter slides on the leather disks, which have been thoroughly greased before the carrier was placed in the shell. Rotary motion is by this means gradually imparted to the carrier, and sudden shocks avoided. When the target is struck the carrier plunges forward, shears off a steel safety pin and brings the firing rod in contact with the shoulder. This drives the rod against the friction pin, which fires the primer and explodes the detonator; the latter denoting the explosive gelatine charge.

To create a delayed action a small socket is turned in the walls of the detonator on a line with the primer tube, the bottom communicating with the chamber of the primer. In the pocket is compressed a fuse composition, the depth of which determines the amount of delay. This delayed action can be regulated from a small fraction of a second to 30 seconds, or more if desired.

The composition powder consists of sulphide of antimony, chloride of potash and sulphur mixed into a paste with a solution of shellac in alcohol. A quantity of the paste is packed into the bore of the primer and the friction pin pressed into it until the lower end of the latter engages in the perforation in the bottom of the primer tube.

The carriers for the 9-in. guns are taken to the firing stand by themselves and are placed in the shells, which are steel and have walls about ½-in. thick. The powder charge for the large gun weighs 30 lbs., and is made up of the ordinary grains of brown prismatic powder. The charge for the smaller gun weighs 6 lbs. and is made by breaking up the large grains. No attempt was made in the trials to determine the ballistic properties of this powder, so pressures and velocities are not known.

The guns used were a Parrott muzzle-loading 60-pdr. rifle and an English Blakeley muzzle-loading 9-in. rifle. The latter gun is one of three that were brought up from Charleston for another series of experiments. Two of the steel guns were burst at former trials for the Justin system, but the third stood the work. These guns were mounted on improvised carriages, and were protected from each other, as well as from their immediate surroundings, by screens made of timber packed with clay. The guns were fired by electric primers, which were connected by wires to a battery behind a bomb-proof several hundred feet to the left and rear of the guns. This bomb-proof was very strongly made, and was of sufficient size to contain all those who were present to witness the trials. Just above the bomb-proof was mounted the photographic apparatus, the tubes for working the shutters being led into the bomb-proof. This portion of the work was in charge of Arthur P. Yates, of Syracuse.

The first series of shots were fired from the 60-pdr. Parrott, the shells weighing 56½ lbs., and the bursting charge 6¼ lbs. The first four shots were fired at a rock cliff 700 ft. distant, and the explosion tore away immense masses of the rock and earth, sending pieces flying to a distance ¼ mile. The fifth shot was directed at a butt about 100 ft. distant. This butt was built of heavy timbers, firmly packed with rammed clay. The face of the butt was formed of 13-in. timbers, protected by a steel plate ⅝-in. thick. The idea of this shot was to penetrate the plate; timber and 16 ft. of clay without explosion. This was most successfully done, the shell remaining in the butt, and its course through the clay being shown by a ridge on top, as though some mammoth mole had been crawling through. The sixth shot was fired with a delayed action fuse, and was intended to penetrate well into the butt before exploding. As a matter of fact it passed through plate and backing and burst after entering the clay to the depth of 1 ft., driving timber and plating toward the guns and sending a mass of clay and splinters away up into the air.

The second series was fired from the Blakeley 9-in. rifle, the shell weighing 225 lbs. and the charge 34 lbs. Three shots were fired at the cliff, where they buried in the rock and exploded, tearing themselves into thousands of pieces, and loosening immense quantities of stone. The next two shells weighed 214 lbs. each, the charge of gelatine being increased to 36½ lbs. They seemed to make still greater havoc with the face of the cliff, which came tumbling down by the ton, while pieces whistled through the air in every direction, some being picked up half a mile from the firing ground. The last shot was fired at a butt protected by 3 ft. of hard wood and 3 ins. of steel plating. This shell was also fitted with a "delayed-action" fuse, and was designed to explode after penetrating into the middle of the butt. The point of the shell got through the plating and exploded in the wooden backing with a terrific report, hurling the plate to the front and grinding the timber to chips and powder. The body of the shell left its mark on the face of the plate, showing that it did not all get through.

The hole in the plate, as shown in the cut, was large enough for a good-sized boy to crawl through, while several people could find room inside the wood backing. The clay butt was also disintegrated in the front portion, while the air was filled with splinters, dust and stones. The trouble with both of the delayed-action fuses can, it is confidently believed, be readily overcome, and their acting too quickly was really the only feature that was not pronounced to be perfectly successful throughout the trials.

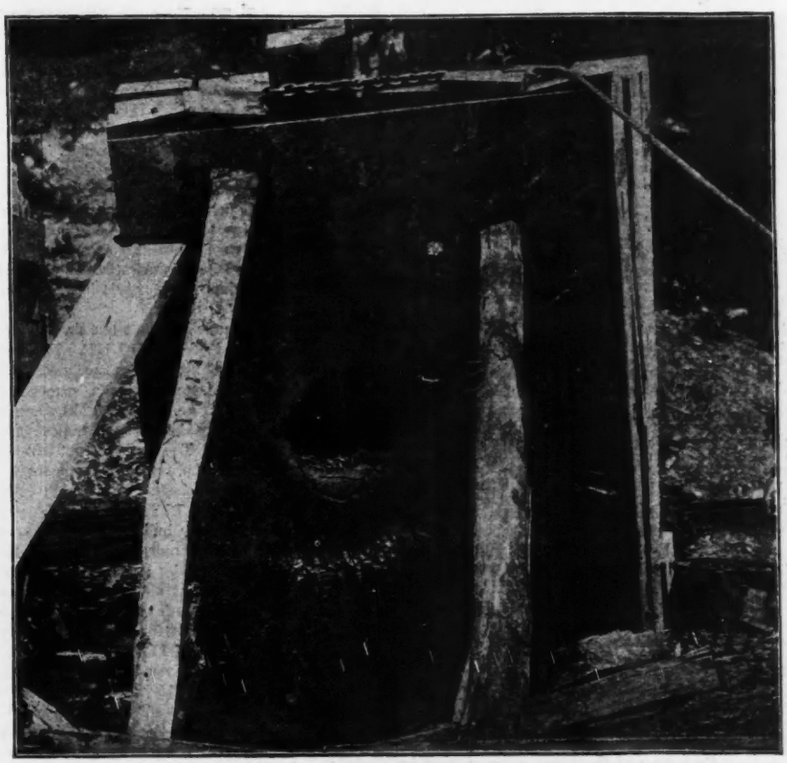


FIG. 2. ARMOR PLATE PIERCED BY JUSTIN PROJECTILE.

STATISTICS SHOWING THE PROGRESS AND PROSPECTS OF RAILWAY CONSTRUCTION IN THE NORTHWESTERN STATES.

(With Map No. 44.)

Illinois.—Existing Roads.

Centralia & Chester.—Track laid in 1891, Oakdale to Nashville, 8.75 miles. Under construction, Nashville to Centralia, 20 miles. Projected, Centralia to Altamont, 76 miles; Sparta to Chester, 20 miles.

1. Chicago & Eastern Illinois.—Track laid in 1891, Tuscola to Shelbyville, 41 miles. Surveyed, Shelbyville to Herrick, 15 miles.

Chicago & New Orleans.—Partly graded, Farina to Iuka, 16 miles. Surveyed, Iuka to Brooklyn, 114 miles. Ch. Engr., C. P. Moore, Chicago.

2. Chicago & Northern Pacific.—Track laid in 1891, Ogden Ave. toward Harvey, 9.85 miles. Track laid since Jan. 1, 1892, extension to Harvey, 14 miles; branch to Lake front, 3.75 miles.

3. Chicago & Ohio River.—Projected, Sidell to Chicago, 130 miles.

4. Chicago, Milwaukee & St. Paul.—Projected, Shullsburg, Wis., to Galena, 20 miles.

5. Elgin, Joliet & Eastern.—Track laid in 1891, East Aurora to Aurora, 1.25 miles.

6. Fulton Co. Narrow Gage.—Projected, Havana to Bates, 45 miles.

7. Illinois Central.—Track laid in 1891, Clyde to Chicago, 9.16 miles.

8. Indianapolis, Decatur & Western.—Surveyed, Decatur to Beardstown, 81 miles.

9. Jacksonville Southeastern.—Track laid since Jan. 1, 1892, Greenville to Durley, 4 miles. Surveyed, Durley to Carlisle, 20 miles. Under survey, Havana to Rock Island, 107 miles.

La Salle & Bureau Co.—Under construction, La Salle to near Ladd, 6.75 miles. Ch. Engr., Isham Randolph, Chicago; Sec., G. Weerts, La Salle.

10. Pawnee.—Track laid in 1891, St. L. & C. R. R. to Auburn, 5 miles. Projected, Pawnee east, 9 miles.

Peoria Belt.—Under survey, extension of belt railway at Peoria, 13 miles. Ch. Engr., Jacob A. Harmon, Peoria.

St. Louis, Chester & Grand Tower.—Under contract, East St. Louis to Grand Tower, 65 miles.

Wabash, Chester & Western.—Under construction, Tamaroa to Mt. Vernon, 22 miles. Ch. Engr., Robert Moore, La Clede Building, St. Louis, Mo.

Projects and Surveys.

11. Chicago, Keokuk & Southwestern.—Projected, Havana to Keokuk, 68 miles. J. H. Anderson, Keokuk, Ia.

12. Chicago, Lake Geneva & Northwestern.—Projected, Chicago to Madison, Wis., 126 miles. Pres., D. C. Dunlap, 526 Rialto Building, Chicago.

Flora & Sailor Springs.—Surveyed, Flora to Sailor Springs, 10 miles. L. W. Barnes, Sailor Springs.

13. Joliet, De Kalb & Northern.—Surveyed, Joliet to De Kalb, 57 miles. Pres., Wm. S. Elwood; Ch. Engr., E. H. Doty; both of De Kalb.

[illegible] Wabash.—Projected, Effingham to Carmi, 75 miles.

Marion & Du Quoin.—Surveyed, Marion to Du Quoin, 37 miles. D. R. Harrison, Herren Prairie.

14. Quincy, Beardstown & Havana.—Projected. Quincy to Havana, 75 miles. David Halstead, Havana.

15. Quincy, Keokuk & Chicago.—Surveyed, Quincy to Ft. Madison, Ia., 50 miles. Ch. Engr., F. C. Horn, Exchange Building, Chicago.

St. Louis, Collinsville & Carondelet.—Surveyed, Madison to East Carondelet, 50 miles. Ch. Engr., S. A. Mitchell, Collinsville.

Terre Haute, Sailor Springs & Chester.—Projected, Terre Haute, Ind., to Tamaroa, 135 miles. Pres., B. F. Scaife; Sec., A. C. Rhoades; both of Sailor Springs.

16. Beardstown, Ft. Madison & Des Moines.—Projected, Beardstown to Ft. Madison, 60 miles. Pres. C. V. Chandler, Macomb.

Total.—Track laid in 1891, 75 miles. Track laid since Jan. 1, 1892, 22 miles. In process of construction, 130 miles. Surveyed or under survey, 554 miles. Projects of some promise, 763 miles.

Wisconsin.—Existing Roads.

17. Ahnapee & Western.—Track laid since Jan 1, 1892. Casco to Ahnapee, 20 miles. Surveyed, Ahnapee to Sturgeon Bay, 19 miles.

18. Chicago, Burlington & Northern.—Surveyed, Prairie du Chien to Wauzeka, 15 miles.

19. Connecting.—Under contract, Chic. & No'w'n Ry. to Chic., Mil. & St. P. Ry., 8 miles.

20. Duluth, South Shore & Atlantic.—Under construction, Iron River to Superior, 40 miles.

21. Goodyear, Nellisville & Northern.—Track laid since Jan. 1, 1892, McKenna to Willston, 10 miles. Graded, end of track to Willston, 5 miles.

22. Green Bay, Winona & St. Paul.—Projected, Whitehall to St. Paul, Minn,, 100 miles.

23. Kewaunee, Green Bay & Western.—Track laid in 1891, Kewaunee to Green Bay, 33 miles.

24. Kickapoo, Valley & Northern.—Track laid in 1891, Wauzeka to Soldiers' Grove, 35 miles. Surveyed, Soldiers' Grove to Tomah, 85 miles.

25. Milwaukee, Lake Shore & Western.—Track laid in 1891, Wausau to Marshfield, 40.5 miles.

26. Milwaukee, Menominee Falls & Western.—Surveyed, Sussex to North Lake, 8 miles. Projected, North Lake to Hartland, 32 miles.

27. Minnesota & Wisconsin.—Under construction, Woodville to Emerald, 10 miles. Pres., C. H. Truesdale; Ch. Engr., R. E. Kirk; both of Woodville.

28. Port Edwards, Centralia & Northern.—Track laid in 1891, extension to Marshfield, 10 miles.

29. Wisconsin Central.—Track laid in 1891, extension to Greenwood, 17.5 miles. Projected, Greenwood to Bateman, 40 miles.

Projects and Surveys.

30. Bayfield, Lake Shore & Western.—Surveyed, Bayfield to Iron River, 40 miles. Pres., R. D. Pike; Sec., W. W. Downs; both of Bayfield.

31. La Crosse, Black River Falls & Eastern.—Projected, La Crosse to Antigo, 150 miles. Pres., Hugh H. Price, Black River Falls.

32. Marinette & Western.—Surveyed, Marinette to Abbottsford, 160 miles. Pres., Jesse Spaulding, Chicago; Sec., G. W. Henley, Marinette.

33. Wisconsin Bee Line & West Superior.—Projected, Milwaukee to West Superior, 360 miles.

Total.—Track laid in 1891, 135 miles. Track laid since Jan. 1, 1892, 30 miles. In process of construction, 63 miles. Surveyed or under survey, 327 miles. Projects of some promise, 738 miles.

Michigan.—Existing Roads.

(Lines within limits of map only.)

34. Chicago, Milwaukee & St. Paul.—Under construction, Ford Siding to Sidnaw, 45 miles.

20. Duluth, South Shore & Atlantic.—Surveyed, Negaunee to North Escanaba, 55 miles.

35. Frost.—Graded, Kenton to Withey, 7.125 miles. Ch. Engr., F. A. Palmer, Kenton.

36. Iron Range & Huron Bay.—Track laid since Jan. 1, 1892, Huron Bay south, 12 miles. Graded, end of track to Champion, 23 miles. Pres., C. H. Buhl, Detroit. Ch. Engr., E. D. Miller; Supt., Sanford Keeler; both of Arvon.

Milwaukee, Lake Shore & Western.—Track laid in 1891, on Ontonagon River branches, 12.76 miles. Track laid since Jan. 1, 1892, on Ontonagon River branches, 5.97 miles.

Projects and Surveys.

Hancock & Calumet.—Projected, Calumet to Lake Linden, 8 miles.

Lake Michigan & Lake Superior.—Projected, Deer Point to Point Seulchoix, 60 miles.

37. Manistique & Negaunee.—Surveyed, Negaunee to Manistique, 91 miles.

Total.—Track laid in 1891, 18 miles. Track laid since Jan. 1, 1892, 18 miles. In process of construction, 75 miles. Surveyed or under survey, 146 miles. Projects of some promise, 68 miles.

Minnesota.—Existing Roads.

38. Brainerd & Northern Minnesota.—Under construction, Brainerd toward Park Rapids, 14 miles. Surveyed, extension northwest, 31 miles. Pres., John S. Pillsbury; Ch. Engr., David Forneri; both of Minneapolis.

39. Cloquet Lumber Co.—Track laid since Jan. 1, 1892, Duluth & Winnipeg R. R., north, 8 miles.

40. Duluth & Iron Range.—Under construction, Western Mesabi junction to West Canton mines, 15.5 miles. Surveyed, West Canton mines to Merritt, 1 mile; Ely, east, 6 miles.

41. Duluth & Winnipeg.—Track laid in 1891, Bass Brook north, 9 miles; Cloquet toward Duluth, 14 miles. Projected, Grand Rapids to Crookston, 150 miles.

42. Duluth, Mesabi & Northern.—Track laid since Jan. 1, 1892, Stoney Brook to White Face River, 24 miles. Projected, branch to Mesabi Mt. mines, 6 miles. Pres., K. D. Chase, Fairbault. Ch. Engr., C. H. Marts, Duluth.

43. Duluth, Mississippi River & Northern.—Under construction, Sec. 9; T. 52; R. 23 W. to Sec. 34; T. 55; R. 22 W., 16 miles. Projected, mile, 16 north, 20 miles. Ch. Engr., W. A. Darfter, Swan River.

Duluth Transfer.—Track laid in 1891, in West Duluth, 2 miles. Track laid since Jan. 1, 1892, in West Duluth, 3.27 miles. Under construction, between Duluth, West Duluth and Ironton, 5.5 miles. Surveyed, West Duluth to New Duluth, 5 miles; car works to St. Louis Bay, 1.5 miles. Projected, several branches to yards, 10 miles.

44. Great Northern.—Track laid in 1891, Halstead to South Dakota line, 1.3 miles; Eagle Bend to Park Rapids, 55 miles. Under construction, St. Hilaire to Red Lake Falls, 14.25 miles; St. Hilaire to Thief River Falls, 7.5 miles.

Itasca Lumber Co.—Track laid in 1891, Compton to Crystal Lake, 15 miles.

45. Winona & Southwestern.—Track laid in 1891, Spring Valley to Iowa line, 15.5 miles.

Projects and Surveys.

46. Mankato & Northeastern.—Surveyed, Mankato to Farmington, 50 miles. Ch. Engr., F. D. Woodbury, Mankato.

Total.—Track laid in 1891, 112 miles. Track laid since Jan. 1, 1892, 35 miles. In process of construction, 73 miles. Surveyed or under survey, 95 miles. Projects of some promise, 206 miles.

North Dakota.—Existing Roads.

44. Great Northern.—Track laid in 1891, Alton to Minnesota line, 10 miles.

47. Minneapolis, St. Paul & Sault Ste. Marie.—Track laid in 1891, Hankinson to Valley City, 81.3 miles; Boynton to Merricourt, 10.2 miles. Under construction, Valley City northwest, 12 miles. (50 miles under construction). Projected, mile 120 to the International line, 80 miles. Under contract, Merricourt west, 10 miles.

Total.—Track laid in 1891, 102 miles. In process of construction, 130 miles. Surveyed or under survey, 15 miles. Projects of some promise, 80 miles.

South Dakota.—Existing Roads.

48. Burlington & Missouri River.—Track laid in 1891, Mystic to Deadwood, 23.55 miles; Minnekahta to Hot Springs, 12.77 miles.

49. Chicago & Northwestern.—Projected, Yankton to Springfield, 30 miles.

50. Dakota, Wyoming & Missouri River.—Partly graded, Rapid City to Mystic, 32 miles. Pres., Wm. T. Coad, Rapid City.

51. Deadwood Central.—Track laid in 1891, Deadwood to Ruby Basin, 7 miles.

52. Duluth, Pierre & Black Hills.—Partly graded. Aberdeen to Faulkton, 42 miles. Located, Faulkton to Pierre, 81 miles. Surveyed, Aberdeen to Oakes, No. Dak., 54 miles. Ch. Engr., B. P. Tilden, Aberdeen.

53. Fremont, Elkhorn & Missouri Valley.—Track laid since Jan. 1, 1892, Deadwood to Ruby Basin, 11.4 miles; branch to Portland mines, 2.4 miles.

54. Rapid City, Missouri River & St. Paul.—Partly graded, Rapid City to Cheyenne River, 41 miles. Surveyed, Cheyenne River to Pierre, 124 miles. Pres., Rich. O. Lake; Ch. Engr., Myron Wheeler; both of Rapid City.

Projects and Surveys.

55. Sioux City, Madison & Northern.—Surveyed, Garretson to Madison, 38 miles. Pres., Chas. B. Kennedy, Madison. Ch. Engr., E. D. Vincent, Sioux City.

Total.—Track laid in 1891, 43 miles. Track laid since Jan. 1, 1892, 14 miles. In process of construction 115 miles. Surveyed or under survey, 282 miles. Projects of some promise, 93 miles.

Nebraska.—Existing Roads.

48. Burlington & Missouri River. Track laid in 1891, Beverly west, 18.5 miles. Track laid since Jan. 1, 1892, 18.5 miles west of Beverly to Weuneta. 23 5 miles Under survey, Nebraska City to Johnson, 20 miles.

56. Chicago, Rock Island & Pacific.—Under survey, Lincoln to Jansen, 42 miles.

57. Missouri Pacific.—Track laid in 1891, Union to Gilmore, 25.5 miles.

58. Yankton, Norfolk & Southwestern.—Under construction, Yankton to Wausau, 30 miles. Under contract, Wausau to Norfolk, 34 miles. Projected, Yankton to Sioux Falls, So. Dak., 61 miles. Pres., N. W. Gifford, Yankton.

Projects and Surveys.

59. Northeastern Improvement Co.—Surveyed. South Sioux City to Horner, 15 miles. Pres., E. D. Smiley, South Sioux City.

60. Sioux City & Northwestern.—Located, Sioux City to Niobara, 80 miles. Ch. Engr., L. F. Wakefield, Sioux City, Ia.

Total.—Track laid in 1891, 44 miles. Track laid since Jan. 1, 1892, 24 miles. In process of construction, 64 miles. Surveyed or under survey, 157 miles.

Iowa.—Existing Roads.

61. Burlington, Cedar Rapids & Northern.—Under construction, Forest City to Armstrong, 31 miles. Located, Armstrong to Eastherville, 14 miles.

49. Chicago & Northwestern.—Under survey, Moville to Sioux City, 18 miles.

62. Chicago, Ft. Madison & Des Moines.—Track laid in 1891, Collett to Libertyville, 4.2 miles. Surveyed, Libertyville to Ottumwa, 25 miles.

63. Iowa Central.—Surveyed, Eddyville to Ottumwa, 18 miles.

45. Winona & Southwestern.—Track laid in 1891, Minnesota line to near Osage, 23.4 miles. Projected, Osage to Mason City, 25 miles.

Projects and Surveys.

64. Nebraska Central.—Projected, Omaha, Neb., to Ft. Dodge, 125 miles. Pres., J. H. Dumont; Ch. Engr., F. W. Kimball; both of Omaha, Neb.

Total.—Track laid in 1891, 28 miles. In process of construction, 31 miles. Surveyed or under survey, 75 miles. Projects of some promise, 150 miles.

Manitoba and Northwest Territory.—Existing Roads.

Calgary & Edmonton.—Track laid in 1891, Red Deer River to Edmonton, 98 miles; Calagary to Mosquito Creek, 54 miles. Track laid since Jan. 1, 1892, Mosquito Creek south, 15 miles. Under construction, extension to Ft. McLeod, 50 miles.

Canadian Pacific.—Track laid in 1891, Hartney southwest, 85 miles; Wethven to Nesbitt, 5.6 miles. Track laid since Jan. 1, 1892, Oxbow southwest, 42 miles. Under construction, Deloraine to Napinka, 18 miles; Nesbitt to Souris, 18.5 miles; Monteith west, 30 miles.

65. Port Arthur, Duluth & Western.—Track laid in 1891, mile 43 to mile 58, 15 miles. Partly graded, mile 58 to Gunflint Lake, 27 miles.

Total.—Track laid in 1891, 258 miles. Track laid since Jan. 1, 1892, 57 miles. In process of construction, 144 miles.

THE PACIFIC GAS OR GASOLINE ENGINE.

Gas engines for motive power have advantages over steam engines in certain cases, more especially for small plants and separate machines, and on the Pacific coast a number of these engines are used for driving launches, irrigating and other pumps, printing presses, electric light dynamos, etc. The type of engine to which we refer is the Pacific gas or gasoline engine, manufactured by the Pacific Gas Engine Co., of San Francisco, Cal. It is of the single acting type. A mixture of air and gas is drawn into the cylinder during the outward stroke of the piston and compressed by the return stroke, and then ignited by an electric spark from a small battery, power being produced by the expansion of the gas. The consumption is said to be from 20 to 25 cu. ft. of coal gas, or about one-eighth to one-sixth of a gallon of gasoline per I. HP. per hour, and the engine can be run with coal gas, water gas, natural gas or with gasoline or naptha vapor. The carbureter or gasoline tank has a gas chamber on top, with internal serpentine passages through which the air passes, absorbing what gas is necessary to make it ignitible, the pipe to the engine leading from the chamber. In one case where this engine is used the carbureter is placed in a box buried in the ground, 40 ft. from the engine. Dry or wet batteries can be used.

The engines are made in about ten sizes, with one or two cylinders, and of ¾ to 15 HP. The former covers a floor space of 20×24 ins., weighs 250 lbs., and costs $180; the latter covers a space 48×60 ins., weighs 3,000 lbs., and costs $1,250, the prices including driving pulley, battery, oil tank for gasoline or gas bag for gas. The engine is not reversible, and for boat engines the reverse movement is attached to the propeller shaft. The double cylinder engines are of 8, 10 and 15 HP., and both vertical and horizontal engines are built. A 15-HP. vertical engine at the Eureka Foundry is said to be doing the work formerly done by a steam engine with cylinder 8×16 ins., and at about half the expense, while occupying only a tenth of the space, and several engines are being built for street car purposes. A similar marine engine of 17 HP. for a launch 40 ft. long and 8 ft. beam gives the boat a speed of about 10 knots, while a 15-HP. engine used for auxiliary power on a yacht 62 ft. long and 18 ft. beam gives her a speed of 4½ knots without sails. A 2-HP. engine driving a triple acting pump gives a capacity of 2,000 gallons per hour, the cost of running being about 5 cts. per hour.

The Otto gasoline engine was described in our issue of Feb. 20, and some notes on the performance of gas engines and other internal combustion engines were given in our issue of March 19.

PERSONALS.

Col. Worth has been appointed City Engineer of Creede, Colo.

Mr. Andrew Onderdonk has changed his address from Winston, N. C., to Morgantown, W. Va.

Mr. Louis Coste has been appointed Chief Engineer of the Public Works Department of Canada, at Ottawa, Ont.

Mr. Benjamin Norton, Vice-President of the Long Island R. R., has also been appointed General Manager of the road.

Mr. F. A. Dunham, civil engineer, Plainfield, N. J., has been appointed engineer in charge of street improvements at Olean, N. Y. He is also engaged in getting up plans for a system of sewers for Sewickley, Pa.

Mr. J. C. Birdsell has been appointed Trainmaster of

the Wyoming Division of the Burlington & Missouri River R. R., with headquarters at Alliance, Neb. Mr. H. C. Nutt, Jr., has been appointed Assistant Superintendent, with headquarters at Edgemont, Neb.

Mr. J. W. Dabney, an engineer on the Missouri, Kansas & Texas Ry., died at Denison, Tex., recently.

Mr. W. J. Crocker, City Engineer of Waxahachie, Tex., has resigned to accept a position as engineer on the extensions of the Missouri, Kansas & Texas Ry.

Mr. D. J. Durrell, Mechanical Engineer of the Illinois Central R. R., has resigned to accept the position of Mechanical Engineer for the Illinois Steel Co. Mr. A. Rosing, formerly with the Grant Locomotive Works, at Chicago, has been appointed to succeed Mr. Durrell.

Mr. David J. Lewis, Jr., has been engaged by the Stearns Mfg. Co., of Erie, Pa., to have charge of its new department for the manufacture and sale of standpipes and other structural iron work, with headquarters in the Rookery Building, Chicago. Mr. Lewis was connected with the Southwark Foundry & Machine Co., for five years, and the 90-in. Belpaire boilers built by that company were constructed under his supervision. During the past two years he has been located in Chicago, and until September last was in charge of the construction and erection department of the Porter Boiler Mfg. Co., of Chicago.

Mr. Thomas Cook, the originator of railway excursions, and the founder of the railway ticket and excursion firm now known as Thomas Cook & Sons, died near Leicester, England, recently, at the age of 84. He was born in Melbourne, England, in 1808, and entered the printing business. In June, 1841, he conceived the idea of running a special train from Leicester to Loughborough, to carry people to a public temperance meeting. He made arrangements with the railway company to furnish the train, and also made arrangements to feed the people and carry them from the train to the park where the meeting was held. On July 5, therefore, the first publicly advertised excursion train was run in England, and carried 570 passengers for the round trip at 25 cts. each. This success led to other and more extended excursions, and 1864 the Continent was first included in the excursion system. At the present time this system covers the entire world, and includes ordinary travelers and tourist parties in one or several countries, exposition traffic, and the carrying of mails on the Nile and of pilgrims to Mecca. It has also included many special arrangements, such as the travels of royalty, and the transfer of troops up the Nile during the Egyptian campaign of 1882, and for the expedition to rescue General Gordon in 1884-85. The work of Mr. Cook, and subsequently of the firm which he founded, has led the way in developing local and international travel for pleasure and business. In 1891 the firm celebrated its jubilee by a grand banquet in London. It is now the official agent for the World's Columbian Exposition and the Royal British Commission for the exposition. Mr. Thomas Cook retired in 1878, and since that time his son, Mr. J. M. Cook, has been the managing head of the firm.

NEW PUBLICATIONS.

SOUTHERN AND SOUTHWESTERN RAILWAY CLUB.—Constitution and proceedings; Secy., S. A. Charpiot, Macon, Ga., 12 mo., pp. 37.

This contains the proceedings of the regular meeting at Atlanta, Ga., April 21, 1892, at which reports were presented on "Flue Setting," and "Draft Timbers and Draft Rigging."

IRRIGATION MANUAL.—Containing Useful Information and Tables Appertaining to Irrigation by Artesian Waters in the States of North and South Dakota, together with Many Tables, Rules and Items of Miscellaneous Information of Value to Farmers and Business Men. By W. P. Butler, C. E., Aberdeen, So. Dak. Huron: Shannon & Longstaff; 12mo., pp. 204; 78 tables; 24 illustrations; 25 cts.

As is indicated by the above, this book is designed more for popular use than for the use of engineers. Many of the tables are from well known engineers' pocket books, but some of them are said to be original. The book seems likely to prove very useful to those for whom it was intended, and brings together some scattered information of use to any irrigation engineer.

DESCRIPTIVE INDEX OF CURRENT ENGINEERING LITERATURE.—Vol. 1, 1884-1891, inclusive. Chicago, Association of Engineering Societies, J. W. Weston, Secy., Lakeside Building. 8vo., pp. 475; $2.50.

Over 11,000 notes and references are contained in this work, the list of periodical publications indexed covering four pages. The volume is a reprint of indexes which have been appearing monthly for years, and which we have often favorably noticed, as by long odds the best existing index to engineering papers, not to say the only one. As such, we cordially recommend it to all our readers feeling the need of some means of ready reference to recent articles of value on any given subject, and what engineer does not? Orders for the work will be filled from this office, or by Mr. Weston; and it is but just to add further that the work is not published for profit, but barely at cost. Necessarily it would be easy to pick flaws with such an index in respect to omissions. Only the more important articles can be referred to, but many articles of real value on almost any subject will be found indexed. We advise all our readers to buy it, and as the edition is quite limited they had better order soon.

THE NEWPORT WATER-WORKS.—Report of Samuel R. Honey, Mayor, and Expert Testimony by Desmond Fitz Gerald, C. E., Chas. A. Siegfried, M. D., U. S. N., and Geo. E. Waring, Jr., M. Inst. C. E. Pamph., pp. 40 and folding sheet of illustrations.

As has previously been stated in these columns Mr. Samuel R. Honey was some months ago elected Mayor of Newport on a water-works reform ticket. He caused to be introduced in the legislature bills designed to give the city sanitary control of the water supply furnished by the Newport Water-Works Co., the power to regulate the water rates charged by the company and the privilege of buying the company's works. The above experts were employed by the city during the attempt to pass the bills named.

Col. Waring gives a general review of the Newport water-works, showing, among other things, that the quality of the water has for some time been poor. Dr. Siegfried gives bacteriological proofs that the water supply is often unfit for use. Mr. Fitz Gerald discusses the shallow flowage of the supply ponds and estimates that about $182,000 should be expended to remedy this defect. The value of the company's works he estimates as $458,000. Mr. Fitz Gerald closes by advocating the municipal ownership of the works and condemning the use of cement lined pipes.

COMMERCIAL INFORMATION CONCERNING THE AMERICAN REPUBLICS AND COLONIES. Bulletin No. 4; Bureau of the American Republics. Pub. Doc., 8vo., pp. 286.

The contents of this "bulletin," which is a good sized volume, are of a decidedly miscellaneous character, but seem to indicate that the Bureau is doing a good deal of useful work. For the most part the volume is occupied by the latest commercial statistics of the several countries. A great many interesting facts of a more miscellaneous character are recorded, as for instance the following remarkably liberal agreement which has been signed by practically all the regular transportation lines trading between our own and other North and South American ports:

(1) To carry free of cost the Commissioners of the Latin-American Department of the Exposition and their families.

(2) To carry free of cost all collections furnished by foreign governments for exhibition, provided the expenses of handling are paid.

(3) To carry for one-half the ordinary rates all articles sent by private parties for exhibition—that is, one full rate having been paid to the United States, the same articles will be carried back without further charge, to the port from which they were originally shipped.

(4) To reduce passenger rates during the Exposition to cover simply the cost of boarding the passengers.

DREDGING ON THE PACIFIC COAST.—A History of the Various Appliances Used, their Modes of Operation, Details of Construction, and Comparative Merit. By John H. Miller, of the San Francisco Bar. 8vo. pamph., pp. 29, 8 plates.

This publication is doubtless made chiefly for partisan rather than purely scientific purposes. This is frankly confessed in the preface, which reads as follows:

While acting as attorney for Mr. A. B. Bowers in the litigation now (July 1, 1892), pending for infringement of his various patents on dredging appliances, I had occasion to examine the history of the dredging industry on the Pacific Coast. The result of my examination is embodied in these pages. In presenting them to the public, it is more than likely that I may be accused of partisanship. I contend, however, that no statement has been made which has not either been heretofore verified under oath by reputable witnesses, or which cannot be hereafter so verified. My object has been to give a fair and impartial statement of the facts as I found them. If I have not succeeded in so doing, let him who denies it point out the error.

So far as we are able to judge from this distance, and with our knowledge of the facts, this statement is fairly well justified; at least, Mr. Miller has succeeded in making a very interesting compilation. He states with truth, that "remarkable as it may appear, the Pacific Coast leads the world in this matter," and we testify our appreciation of the interest of his monograph by the very full abstract which appears in another column.

STATE GEOLOGIST OF NEW JERSEY.—Report for 1891. John C. Smock, State Geologist; C. C. Vermeule, New York, Consulting Engineer. 8vo., pp. 270; 10 illustrations; one folding diagram and map of New Jersey in pocket.

This volume contains a paper by Prof. R. D. Salisbury on the "Drift of Pleistocene Formations of New Jersey." Mr. C. W. Coman has a paper on the "Oak Land and Pine Land Belts and Their Relation to Agriculture."

The most valuable part of the report to engineers is the 36 pages by Mr. C. C. Vermeule on "Water Supply and Water Power." This is a progress report of the work which was started sometime ago and which it was expected would be finished in May last. Gagings of several streams are reported for the year and a diagram is given showing the daily flow of the Ramapo River at Pompton for 1890 and of the Musconetcong, Great Egg Harbor and Batsto Rivers for 1891. A list is given of all the water powers of the state which are now or have been recently utilized. It is estimated that the total utilized water power in the state is 30,870 HP., net.

"Artesian Well Horizons in Southern New Jersey" are discussed by Mr. Lewis Woolman. The work done by the Geological Survey of New Jersey, both in regard to water power and artesian wells, is of great value to the state.

Some notes on iron mines and mineral statistics close the report. The total iron ore output of New Jersey for 1891 is given as 551,358 tons. The output of zinc ore for 1891 is said to have been 76,032 tons.

The map of New Jersey accompanying the report is on a scale of five miles to the inch.

TRADE PUBLICATIONS.

PALACE CARS.—Wagner Palace Car Co., New York. 8vo., pp. 36.

This is an elaborately printed and illustrated descriptive list of Wagner sleeping, drawing room, hotel, private and special cars, with plans and interior views, and charter rates for private, theatrical or special service. There is also a view of the company's car works at Buffalo, N. Y., and a folding plate with elevation and plan of a train of Wagner cars. The book is arranged with a handsome interior view, printed in halftone, on one page, and on the opposite page a plan of the car with particulars of dimensions, fittings, accommodations, etc. Plans of some of the Wagner cars have been in our issues of Oct. 10, 1891, and June 16, 1892, and we give elsewhere some particulars of the company's private car service.

WATER METERS.—Thomson Hydraulic Co., New York 12mo., pp. 11.

This little explanatory pamphlet is issued by the new company which has been organized by Mr. John Thomson, Mr. F. A. Lovecraft, and Mr. E. L. Abbott, formerly of the Thomson Meter Co., and which will shortly put on the market the Neptune water meter, a new invention of Mr. John Thomson. The Neptune meter is claimed to be an advance and improvement upon the original "Thomson" meter, which has been so long and so favorably known, and which is now controlled by an entirely different company, in which the incorporators of this new company hold a minority of the stock.

SOCIETY PROCEEDINGS.

AMERICAN STREET RAILWAY ASSOCIATION.—The eleventh annual convention will be held at Cleveland, O., Oct. 19, 20 and 21. Reports will be presented on the following subjects: "Power House Engines," "Relative Cost of Operation of Horse, Cable and Electric Railways," "Standards for Electric Railways," "Form of Street Railway Electrical Statistics," "A Model Electric Street Railway Roadbed and Underground Wiring," "A Perfect Overhead Construction," and "Economy of Machine Shops for Electric Street Railways."

COMING TECHNICAL MEETINGS.

ASSOCIATION OF CIVIL ENGINEERS OF DALLAS.
Aug. 5. Secy., E. K. Smoot, 608 Commerce St.
TECHNICAL SOCIETY OF THE PACIFIC COAST.
Aug. 5. Secy., O. von Geldern, 819 Market St., San Francisco.
SWEDISH ENGINEERS' CLUB.
Aug. 6. Secy., P. Valentine. At 231 Union St., Brooklyn, and 246 North 10th St., Philadelphia.
NORTHWEST RAILROAD CLUB.
Aug. 6. Union Station, St. Paul.
WISCONSIN POLYTECHNIC SOCIETY.
Aug. 8. Loan & Trust Bldg., Milwaukee. Secy., M. G. Shinks.
CIVIL ENGINEERS' SOCIETY OF ST. PAUL.
Aug. 8. Secy., C. L. Annan.
ENGINEERS' AND ARCHITECTS' CLUB OF LOUISVILLE.
Aug. 11. Secy., Edward Mead, Norton Building.
ENGINEERING ASSOCIATION OF THE SOUTHWEST.
Aug. 11. Secy., O. H. Landreth, Nashville, Tenn.
SOUTHERN AND SOUTHWESTERN RAILWAY CLUB.
Aug. 18. At Atlanta, Ga. Secy., F. A. Charpiot, Macon, Ga.
SCANDINAVIAN ENGINEERING SOCIETY OF CHICAGO.
Aug. 18. Secy., C. F. Franson, 113 Adams St.
ENGINEERS' CLUB OF CINCINNATI.
Aug. 18. Secy., J. F. Wilcox.
MONTANA SOCIETY OF CIVIL ENGINEERS.
Aug. 20. Secy., F. D. Jones, Helena.
NEW ENGLAND ROADMASTERS' ASSOCIATION.
Aug. 24, 25. Springfield, Mass. Secy., G. L. E. French, Northampton, Mass.
ENGINEERS' CLUB OF PHILADELPHIA.
Sept. 3. 1122 Girard St. Secy., L. F. Rondinella.
AMERICAN SOCIETY OF CIVIL ENGINEERS.
Sept. 7. Secy., F. Collingwood, 127 East 23d St., New York
WESTERN RAILWAY CLUB.
Sept. 20. Rookery Building, Chicago. Secy., W. H. Marshal.
ENGINEERS' SOCIETY OF WESTERN PENNSYLVANIA.
Sept. 20. Secy., E. N. Clark, Pittsburg, Pa.
ENGINEERS' CLUB OF ST. LOUIS.
Sept. 21. Secy., Arthur Thacher, Odd Fellows' Building.
CENTRAL RAILWAY CLUB OF BUFFALO.
Sept 28. Secy., Jas. Macbeth.
ROADMASTERS' ASSOCIATION OF AMERICA.
Oct. 18. Chattanooga, Tenn. Oct. 19. Atlanta, Ga. Secy., J. H. K. Burgwin, Grand Rapids, Mich.
AMERICAN STREET RAILWAY ASSOCIATION.
Oct. 19, 20, 21. Cleveland, O. Secy., Wm. J. Richards Brooklyn, N. Y.

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AND

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D. McN. STAUFFER, A. M. WELLINGTON.....EDITORS

CHAS. W. BAKER, E. E. R. TRATMAN, M. N. BAKER, F. P. BURT, } ASSOCIATE EDITORS

GEO. H. FROST.....BUSINESS MANAGER

SUBSCRIPTION RATES: one year, $5.00; 6 months $2.50; 4 months, $2.00; single copies, 15 cents. To all foreign countries in the Postal Union, add $2.08 to above prices for postage. Subscribers can have the mailing address of their paper changed as often as they desire. Send both the old and the new addresses. No club rates allowed.

The date when the subscription expires is on the address label on each paper, the change of which to a subsequent date becomes a receipt for remittance. No other receipt is sent unless requested.

ADVERTISING RATES, 20 cents per line agate measure. Schedule sent on request. Changes of advertisements must be in hand on Monday afternoon; new advertisements Tuesday afternoon; transient advertisements, not later than Wednesday noon. The last pages go to press early on Thursday. We shall be obliged if subscribers who fail to receive their papers promptly will notify us without delay.

If the "School Census Committee" of Chicago can be trusted, in the two years which have elapsed since the national census was taken Chicago's population has already increased over 300,000, or from 1,100,000 in round figures to over 1,400,000. The same rate of increase, if continued through the decade, would bring Chicago's population up to over 4,000,000 by 1900! That, of course, is not to be expected, but there can be no doubt that the World's Fair and other causes have made the growth of Chicago specially rapid in the past two years, and it seems quite certain that long before 1900 Chicago will outnumber New York as at present constituted, and be a very good second to the true metropolis of New York, which includes Brooklyn, Jersey City, etc. The impressive figures of its growth will bear repetition in connection with this last announcement. We add percentages of increase:

Cen. of	Population.	P. c. increase.
1850	29,963	....
1860	109,260	264.6
1870	298,977	173.6
1880	503,185	68.3
1890	1,099,850	118.1
1892	1,428,318	273.6

Considering all circumstances, the last line of this pyramid is not so disproportionate to the rest that it need be received with skepticism. Continuing to add 150,000 per year only, Chicago's population will be 2,600,000 in 1900. Continuing in geometric ratio it will be 4,100,000.

A city with such a future crowding upon it will do well not to take half measures either with its sewage disposal or water supply. More especially, it should realize in time that it can never expect to get pure water from its immediate water front, and that an aqueduct 40 miles long along the flat shores of the lake would cost much less than four miles of tunnel and would insure pure water at all times for a century to come.

The results which have been achieved in the latest tests of American armor plate, recorded elsewhere in this issue, must surprise even those most familiar with the work which our manufacturers and inventors have been doing along this line. Stated in brief the facts are that a 10½-in. nickel steel plate, its surface hardened by the Harvey process, received without any injury of importance the impact of five sharp-pointed chrome steel projectiles, each weighing 250 lbs., and moving at the rate of a mile in three seconds. Each of these heavy missiles struck the plate with an energy of 5,644 ft. tons, an amount of energy equal to that of a railway train of 420 tons (or say a ten-wheel locomotive and ten loaded freight cars) moving at a speed of 20 miles per hour. Yet not one of the five projectiles caused any cracks of the plate or was able to penetrate into it farther than about 3 ins., though five much lighter blows shattered similar plates less than two years ago, which were then regarded with justice as a great advance over previous practice. It would be difficult to find a more impressive illustration of the possibilities of combined toughness and hardness which exist in modern steel. Those who still insist that steel is essentially a brittle metal should give careful consideration to the results of these tests.

It must be said that this test, taken in connection with the test made by the naval officers on a twin plate which showed results not so good, but much better than anything before attained, proves more fully than any previous test has done the value of the Harvey process. This process consists, as described in our issue of Oct. 24, 1891, of carbonizing the surface of the plate by heating it to a high temperature in contact with charcoal and then hardening it by a water bath. This process in connection with the use of nickel, which toughens the steel and prevents its cracking, has enabled American manufacturers within less than two years after beginning operations to produce an armor plate far superior to anything which the European manufacturers, with all their long experience, have as yet been able to turn out. Certainly such achievements in metallurgy will be fruitful of results in peace as well as in war. Mr. Harvey was a prolific inventor in other directions before he turned his attention to the treatment of steel, and we may hope to see him apply his process to other materials than armor plates.

The success just recorded is another of many evidences that America is fast taking the lead of all other countries in metallurgical progress. At the present rate of advance the time is near when our manufacturers will begin to compete successfully with those of England for the orders of foreign nations for ships of war and war materials. And until plates of similar quality to those just tested are produced in England it would seem as if the question of price would be a secondary one.

The troubles likely to arise in contract work let without sufficient information as to the conditions under which the work will be prosecuted have been exemplified in a lawsuit recently tried in England over a dispute which has been already noted in these columns. The main question was whether the employer or contractor should bear the burden of a great increase over the estimated cost, due to the unstable character of the soil in which the work was done, and of which no test or examination had been made by either party. The contractor undertook the construction of sewers for the city of York, and the contract included the usual clauses providing that the sewers were to be constructed to the satisfaction of the engineer, and the power was reserved to him to vary or extend the quantities of the work, to alter the line level or portion of any work, to increase or change the size, character or kind of work, and the contractor was not to have any claim upon the city for any such extension or variation, other than for the work actually done, according to the prices of the contract. The "Engineer" thus summarizes the nature of the testimony:

The contractor, on the contract being entered into, found the soil was of so muddy a nature as to require a great deal of propping by timber to prevent it from falling in, and so the work was executed under great difficulties and at far greater expense than contemplated; indeed, the contractor stated, and, as the judge said, correctly, it would cost three times the amount of the estimated expense. Under these difficulties, however, he had completed 136 ft. of the sewers, and, as was admitted, this part was well executed by him. But, as he alleged, the pressure of the muddy soil on each side altering the size of the sewer, the engineer, or one of the inspectors, under him, again and again required the work to be cut and done in another way, which was done, the contractor said, more than once without orders in writing. When the engineer again required him to cut out and reconstruct a part of the sewer completed, he refused to do this unless ordered in writing and paid for extras. This was not agreed to, and on that day he stopped the work and withdrew his men, on which the corporation, having given him notice, put an end to the contract, and took possession of the contractor's plant.

The contractor claimed that the contract was oppressive, and that the orders of reconstruction should have been given him in writing, entitling him to extra payment. The court decided, however, that while he was no doubt imprudent to enter upon the contract he could not afterward call for it to be amended, and had no legal ground for throwing it up. He had not made any investigation as to the nature of the soil, and must take the consequences. Owing to the character of the material met with, the engineer gave orders which he was entitled to give without allowing any extra payment to the contractor.

We think the court was right in this case, but it is a quite different case when the contractor is required to "bet against the Almighty" by taking all the risk of errors in alleged sections exhibited to him by the engineers of the work as a basis for making up his bid, as happened at the Lachine bridge, and as has happened on many other like works. It should be a general principle in all work involving excavation of any magnitude, that the engineer should investigate the character of the material to be met with, not only to provide for the proper design and carrying out of the work, but also to avoid as far as possible the delay and expense to which his employer is liable to be subjected by such lawsuits as the one above referred to, and having thus investigated, his company, or the city, as the case may be, should make itself responsible for the substantial correctness of the facts shown. On the other hand, the contractor who blindly takes a contract without knowing the conditions under which he will have to work is not deserving of much sympathy from a technical point of view. The conclusion of the whole matter is that the contractor should insist in advance on being furnished with definite information as to the soil he has to deal with, or else on some clause protecting him against unexpected developments—or else not grumble if he is ruined.

RAILWAY CONSTRUCTION IN THE NORTHWEST.

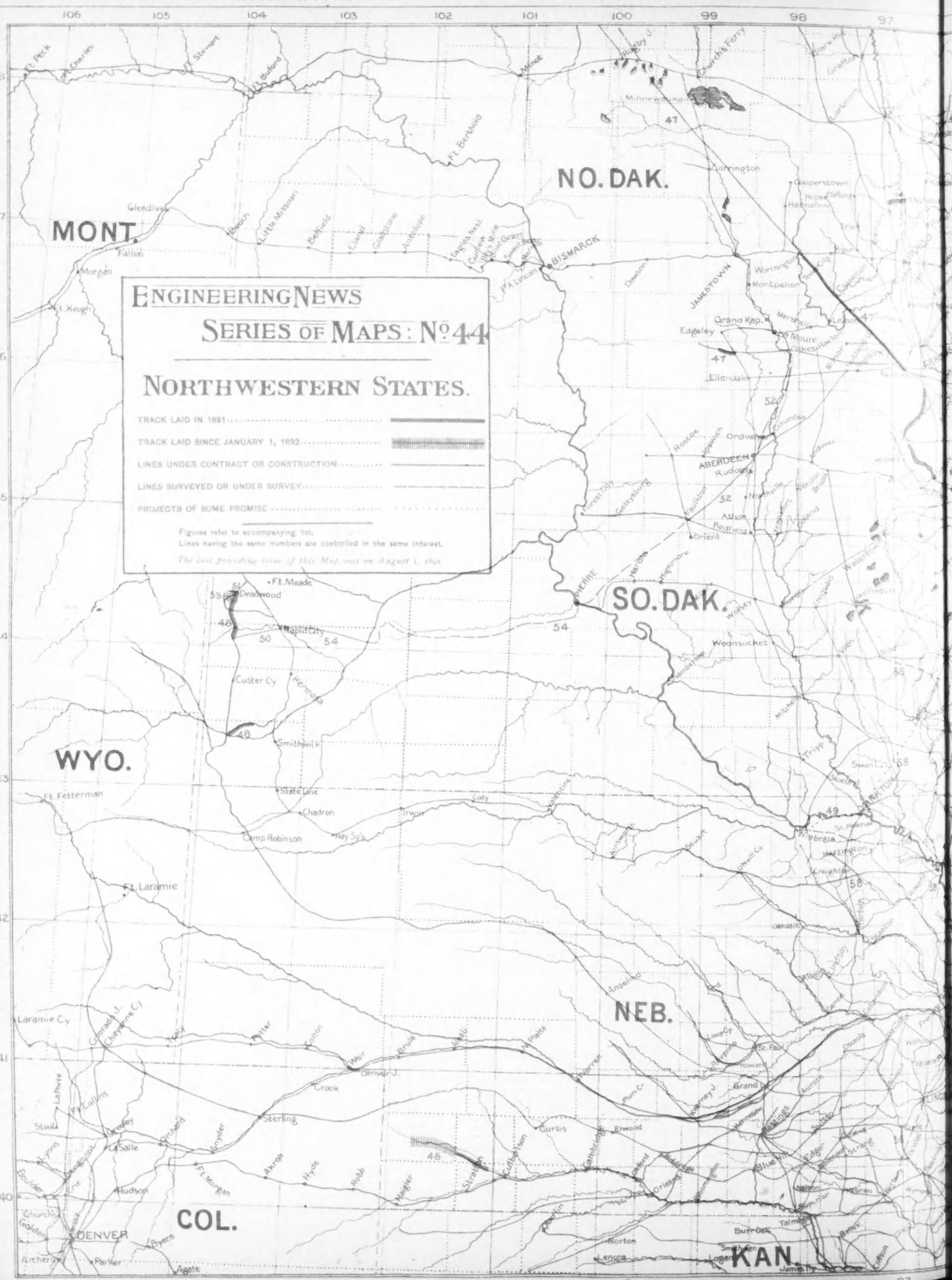
As was to be expected, the map and statistics of railway construction in the northwestern states which we present in this issue show a considerable decrease from last year's figures in the amount of new work in progress, and a very great falling off in the amount of track laid to date. The figures as collected show that there are 4,467 miles of all classes of work under way as compared with 5,874 miles one year ago, a decrease of 23.9%. This percentage of decrease is slightly larger than was shown by our statistics (Eng. News, April 11, 1892) covering the 14 states east of Chicago (19.9%), and less than one-half that shown by similar statistics (Eng. News, June 23, 1892) of the Southern states (47.5%). The mileages of new work of the several classes in progress in each state are shown in the accompanying table:

	—Track laid.—		Under	Surveyed	Projects
	In year	To date	contract or	or under	of some
States.	1891.	1892.	construction.	survey.	promise.
Ill.	75	22	130	554	763
Wis. ...	135	30	63	327	738
Minn. .	112	35	73	95	206
N. Dak.	102	...	130	15	80
S. Dak.	43	14	115	282	93
Neb. ...	44	24	64	157	....
Iowa. ..	28	...	31	75	150
Man. ..	258	57	144	....	....
Total.	797	182	750	1,505	2,030

Comparing these totals with those published in connection with our immediately preceding map of this section we have the following results at the dates named:

	—Track laid.—				
	Portion of year to date.	Year previous.	Under construction.	Under survey.	Projected.
Aug. 1, 1891	.322	1,634	1,017	1,929	2,606
Aug. 4, 1892	.182	797	750	1,505	2,030
Dec. 1892	.140	837	237	424	576
Dec. P. c.	43.5	51.3	26.2	21.9	22.1

To state the reason of this decrease in activity is largely but to rehearse what has been said in connection with our previous maps this year, and what is familiar to all who have paid any attention to the tendency of railway construction. Following the financial disturbances of the fall of 1890 there was a general depression in all industries throughout the whole country, and especially in the South and on the Pacific coast. The railway system of the coun-


ENGINEERING NEWS
SERIES OF MAPS: No. 44
NORTHWESTERN STATES.
TRACK LAID IN 1891
TRACK LAID SINCE JANUARY 1, 1892
LINES UNDER CONTRACT OR CONSTRUCTION
LINES SURVEYED OR UNDER SURVEY
PROJECTS OF SOME PROMISE
Figures refer to accompanying list.
Lines having the same numbers are controlled in the same interest.
The last preceding issue of this Map was on August 1, 1891.
MONT.
NO. DAK.
SO. DAK.
NEB.
WYO.
COL.
KAN.
BISMARCK
PIERRE
ABERDEEN
JAMESTOWN
DENVER
Ft. Meade
Deadwood
Rapid City
Custer Cy
Hermosa
Smithwick
State Line
Chadron
Ft. Fetterman
Camp Robinson
Hay Sp's
Ft. Laramie
Laramie Cy
Denver J.
Crook
Sterling
Ft. Morgan
Akron
Hudson
Ft. Collins
Greeley
Orchard
Snyder
La Salle
Stoud
Boulder
Erie
Golden
Church's
Ayers
Archer's
Parker
Agate
Glendive
Fallon
Morgan
Ft. Keogh
Ft. Peck
Charles
Stewart
Ft. Buford
Minot
Ft. Berthold
Little Missouri
Belfield
Elbird
Gladstone
Amidon
Eagle's Nest
Carlson
Bill's Mine
Blue Grass
Sweet Briar
Ft. Lincoln
Dawson
Minnewaukan
Rugby J.
Church's Ferry
Carrington
Cooperstown
Hope
Hatton
Harwood
Tiffany
Edgeley
Grand Rap.
Merrifield
Moore
Lakeside
Ellendale
Montpelier
Wimington
Columbia
Roscoe
Ordway
Ipswich
Rudolph
Gettysburg
Faulkton
Athol
Northville
Orient
Redfield
Harrold
Highmore
Wolsey
Woonsocket
Wessington
Tripp
Swan L.
Stoutland
Niobrara
St. Helena
Harrington
Creighton
O'Neill Cy
Oakdale
Norfolk
Madison
Lindsay
Albion
Genoa
Columbus
Fremont
Wahoo
Valley
Ansley
Loup Cy
St. Paul
Ravenna
Howard
Grand I.
Aurora
Hastings
Henderson
Edgar
Blue Hill
Nelson
Superior
Talmage
Burr Oak
Smith Cen.
Logan
Lenora
Norton
James Cy
Bailey
Curtis
Elwood
Cambridge
Oxford
Orleans
Arapahoe
Stratton
Cuthbertson
Wauneta
Imperial
Chase
Wray
Yuma
Idalia
Haigler
Robb
Hyde
Akron
Lyons
Longmont
Loveland
Berthoud
Estes Park
Platteville
Evans
Greeley
Eaton
Windsor
Timnath
Wellington
Laporte
Ft. Collins
Stoud
Crook
Denver J.
Julesburg
Sidney
Potter
Cotton
Lodge Pole
Chappell
Big Spring
Paxton
Ogallala
Brule
Roscoe
Sutherland
North Platte
Hershey
Wallace
Sutton
Hayes Cy
Hayes Cen.
Hayes Cr.
Maxwell
Gothenburg
Lexington
Overton
Elm Cr.
Cozad
Darr
Willow I.
Gothenburg
Lexington
Overton
Elm Cr.
Cozad
Darr
Willow I.
Kearney J.
Grand I.
Plum Cr.
Aurora
Hastings
Henderson
Edgar
Blue Hill
Nelson
Superior
Talmage
Burr Oak
Smith Cen.
Logan
Lenora
Norton
James Cy
Bailey
Curtis
Elwood
Cambridge
Oxford
Orleans
Arapahoe
Stratton
Cuthbertson
Wauneta
Imperial
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Yuma
Idalia
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Denver J.
Julesburg
Sidney
Potter
Cotton
Lodge Pole
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Cozad
Darr
Willow I.
Kearney J.
Grand I.
Plum Cr.
Aurora
Hastings
Henderson
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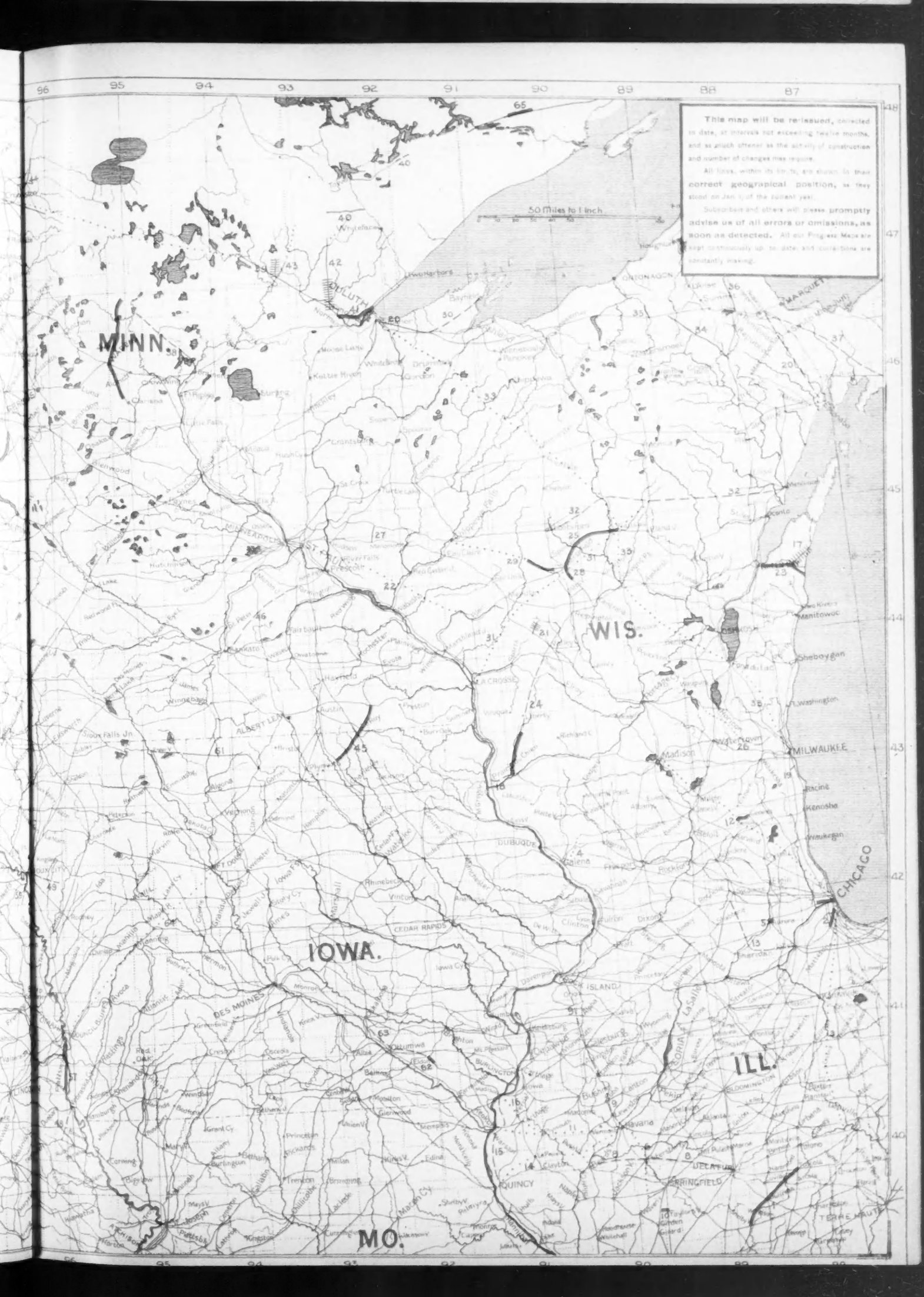
Blue Hill
Nelson
Superior
Talmage
Burr Oak
Smith Cen.
Logan
Lenora
Norton
James Cy
Bailey


This map will be reissued, corrected to date, at intervals not exceeding twelve months, and as much oftener as the activity of construction and number of changes may require.
All lines, within its limits, are shown in their correct geographical position, as they stood on Jan 1 of the current year.
Subscribers and others will please promptly advise us of all errors or omissions, as soon as detected. All our Progress Maps are kept continuously up to date, and corrections are constantly making.
50 Miles to 1 inch
MINN.
WIS.
IOWA.
ILL.
MO.
DULUTH
MINNEAPOLIS
ST. PAUL
LA CROSSE
ALBERT LEA
DUBUQUE
CEDAR RAPIDS
DES MOINES
ROCK ISLAND
MILWAUKEE
CHICAGO
QUINCY
SPRINGFIELD
DECATUR
BLOOMINGTON
Two Harbors
Whitefish
Manitowoc
Sheboygan
Racine
Kenosha
Waukegan
Galena
Madison
Oshkosh
Green Bay
Marquette
Sioux Falls Jn
Winona
Rochester
Austin
Mankato
Fairbault
Red Wing
Hastings
Stillwater
Prescott
Hudson
Superior
Ashland
Duluth
Virginia
Hibbing
Grand Rapids
Brainerd
Little Falls
Crookston
Moorhead
Fargo
Grand Forks
Devils Lake
Minot
Bismarck
Mandan
Dickinson
Glendive
Miles City
Billings
Livingston
Bozeman
Butte
Helena
Great Falls
Havre
Shelby
Cut Bank
Kalispell
Missoula
Spokane
Coeur d'Alene
Lewiston
Pullman
Walla Walla
Pendleton
The Dalles
Portland
Vancouver
Astoria
Tillamook
Salem
Albany
Eugene
Roseburg
Grants Pass
Medford
Klamath Falls
Bend
Redmond
Prineville
Madras
Shaniko
Condon
Arlington
Biggs
Wishram
Goldendale
Centralia
Chehalis
Kelso
Longview
Aberdeen
Hoquiam
Raymond
South Bend
Olympia
Tacoma
Seattle
Everett
Bellingham
Blaine
Sumas
Huntingdon
Nelson
Trail
Rossland
Grand Forks
Midway
Penticton
Kamloops
Ashcroft
Lytton
Yale
Hope
Agassiz
Mission
Chilliwack
Vancouver
New Westminster
Victoria
Nanaimo
Courtenay
Campbell River
Port Alberni
Alert Bay
Prince Rupert
Port Simpson
Skeena
Hazelton
Smithers
Telkwa
Burns Lake
Fraser Lake
Vanderhoof
Prince George
McBride
Dunster
Tete Jaune Cache
Jasper
Edmonton
Wetaskiwin
Ponoka
Lacombe
Red Deer
Innisfail
Olds
Didsbury
Carstairs
Calgary
Gleichen
Medicine Hat
Suffield
Bassano
Brooks
Tilley
Empress
Oyen
Hanna
Drumheller
Rosebud
Strathmore
Langdon
Cochrane
Canmore
Banff
Lake Louise
Field
Golden
Revelstoke
Sicamous
Salmon Arm
Kelowna
Vernon
Armstrong
Enderby
Lumby
Cherryville
Kingsgate
Creston
Cranbrook
Fernie
Michel
Sparwood
Elko
Moyie
Yahk
Waldo
Jennings
Whitefish
Kalispell
Columbia Falls
Belton
West Glacier
Essex
Java
Summit
Bonners Ferry
Naples
Priest River
Sandpoint
Newport
Metaline Falls
Ione
Usk
Cusick
Ilwaco
Chinook
Pacific Beach
Hoquiam
Aberdeen
Cosmopolis
Montesano
Elma
McCleary
Shelton
Kamilche
Olympia
Tenino
Chehalis
Centralia
Winlock
Toledo
Vader
Castle Rock
Kelso
Longview
Rainier
Scappoose
St Helens
Portland
Oregon City
Gladstone
Milwaukie
Lake Oswego
Tualatin
Sherwood
Newberg
Dundee
McMinnville
Amity
Dallas
Monmouth
Independence
Albany
Corvallis
Philomath
Alsea
Toledo
Siletz
Yaquina
Newport
Waldport
Florence
Reedsport
Coos Bay
North Bend
Bandon
Port Orford
Gold Beach
Grants Pass
Rogue River
Medford
Ashland
Klamath Falls
Chemult
Crescent
La Pine
Bend
Redmond
Madras
Metolius
Culver
Prineville
Mitchell
Fossil
Condon
Wasco
Moro
Grass Valley
Shaniko
Maupin
Tygh Valley
Dufur
The Dalles
Hood River
Cascade Locks
Bingen
White Salmon
Wishram
Goldendale
Lyle
Klickitat
Bickleton
Roosevelt
Arlington
Rufus
Biggs
Celilo
Pendleton
Hermiston
Umatilla
Echo
Stanfield
Irrigon
Boardman
Heppner
Lexington
Ione
Arlington
Condon
Fossil
Mitchell
Prineville
Redmond
Bend
Sisters
Black Butte
Metolius
Madras
Culver
Crooked River Ranch
Terrebonne
Tumalo
Deschutes
Sisters
Camp Sherman
Black Butte
Metolius
Madras
Culver
Crooked River Ranch
Terrebonne
Tumalo
Deschutes

try, always sensitive to any business disturbances, and in large sections of the country just recovering from the period of extensive construction in 1887 and 1888, was especially affected. The older companies largely stopped any extensive building; the newer companies were, at least, forced to postpone or abandon the work in progress, and in many cases were driven into the hands of receivers, and the various new enterprises, especially those of a speculative character which had flourished during the era of extensive construction, were killed entirely, or forced to abandon any further steps until a more favorable opportunity.

In the states east of Chicago and north of the Ohio River where new construction is largely in the hands of the older companies and consists almost entirely in the building of short local feeders to which a good traffic is assured from the beginning, the effect of the stagnancy of business was the least. New railway construction in the South and West is of a different character. Here there are large sections of country comparatively undeveloped and unable to afford any large traffic to railways for some years, and new lines are built largely for the prospective future traffic; consequently when financial pressure comes they are the first abandoned. Of the seven states covered by our map, five contain large tracts of land, having generally great natural resources in timber, minerals and agricultural lands, but yet undeveloped and thinly populated, and consequently having no immediate urgent demand for railway transportation. This, together with the fact that nearly all of the railway mileage in these states, with the exception of Illinois and Iowa, which are already well supplied with railways, is controlled by a few large companies which have the situation well in hand, has served to prevent any extensive and probably unnecessary construction.

At the same time an examination of the map and figures will show that a liberal amount of new work is in progress. Each of the seven states has a considerable mileage in process of construction, and, except in a few cases, work is in active progress upon all of these, so that unless something unforeseen occurs a very considerable portion of it will be completed this year.

Taking up the work somewhat in detail it will be seen that more work is under way in Illinois than in any other state. Much of this is without the limits of the map, however, and will be considered in connection with our map of the Southwestern states. Active work is in progress upon a very small proportion of this only; over 89.6% of the total mileage being under survey and projected. Only a very limited number of these projected lines will probably be constructed within the next few years, if ever. The various lines in Wisconsin are sufficiently described in our detailed list. The longest of them, the Wisconsin Bee Line & West Superior, has been under way for some time, and its projectors claim to be confident of its early construction. It does not seem probable that any extensive work will be done for some time, however.

Nearly all the active work in Minnesota is in the northeastern part of the state, and consists mostly of lines tapping the timber and mineral lands tributary to Duluth and the neighboring cities. Considerable work is in progress in both North and South Dakota. In North Dakota the Minneapolis, St. Paul & Sault Ste. Marie Ry., or "Soo" line, is pushing work on its northern extension to the Canadian boundary, where it will connect with a branch of the Canadian Pacific Ry., and by which the latter company will, in connection with the Duluth, South Shore & Atlantic Ry., enter into competition with American roads for the grain traffic to the Atlantic seaboard. The two most important lines in South Dakota are the Duluth, Pierre & Black Hills R. R., generally regarded as a Northern Pacific enterprise, upon which work has recently been resumed, and Rapid City, Missouri River & St. Paul R. R. This last company has a line projected to connect the Black Hills region with the Chicago & Northwestern Ry. and the East, at Pierre.

In Nebraska construction has been begun on the long-talked-of line from Yankton, S. Dak., to Norfolk, Neb., and the prospects are good for its completion this year. Beyond this the various enterprises in this state as well as in Iowa are sufficiently described in the detailed list and map, where we have shown the location of the several lines under way.

ENGLISH RAILWAY PRACTICE IN INDIA AND THE COLONIES.

The practice of English railway engineers and managers, and of English railway men generally, in India, the colonies and other new and undeveloped countries has some curious features on which we have often commented. It appears to be marked very frequently by a lack of appreciation of, and adaptability to, surrounding economic circumstances, together with a determined and blind adherence to methods of construction, equipment and operation which are in use "at home," without due regard to local conditions and requirements, differences in traffic, or financial prospects. This element of conservatism in English practice on colonial railways has in many cases led to very unsatisfactory results in construction and operating expenses, in service and train accommodation, and in financial matters generally. These results are not unfrequently sharply criticised in England, as well as in the country affected, more especially with regard to the financial returns; but the real reason for such an unfortunate practice does not seem to be recognized. We give below a letter to the editor from an engineer of some prominence in the government service in India which sheds some light on this point, and in which he points out the evil effects of such blind conservatism in India and the advantages that might accrue from a leavening of the present system with some features of American railway practice:

Sir: We have been expecting to have to face another famine, and as our population has increased enormously since 1876-1877 (the number now to be provided for being over 287,250,000) our chances of being able to find food for such a host were small indeed. Fortunately, by the mercy of God, we have had rain enough to raise another season's food supply, but the problem before England is a difficult one. These people multiply in times of peace like rabbits, and their agriculture is as poor as it was 2,000 years ago. The question is, how are they to get a good meal a day. There is no doubt you have in America solved one of the great questions of the day, most successfully, and have shown the whole world by your railways how a system of public works can be carried out in the most economical manner, so as to afford every advantage to the community in general and be very remunerative at the same time. English engineers and railway people will not follow your example until they are shamed into it. John Bull prides himself on his obstinacy, and pays very dearly for it, as he did in the matter of Corn Laws, paying 90 shillings a quarter for wheat, because he grew it himself, when he could have bought it all over the world at about 33 shillings! Adam Smith alone stood out against such a policy, and it took nearly a century and almost a civil war to get the Corn Laws abolished. John Bull has his railways, and will stick to them, but the mischief is that he has introduced this system into a poor country like India, where people live in mud huts with thatched roofs, the rent of which is about six pence (12 cts.) a month each. The railways here have been at work for half a century, but have made no improvements whatever on the habits of the people. As soon as people at home see that they will have to be taxed to support India, they will wake up out of their dream and perhaps set to work to improve the industrial habits of these people. So far as my own experience goes, it is only by stimulating the efficiency of industry by open competition, as you have done so wonderfully in the United States in your railway practice, that one country can keep ahead of all others. Australia is trying to keep labor at the highest possible rates, and is now beginning to suffer the consequences.

The condition of affairs described in this letter exists to a very considerable extent throughout India, large sums of money being spent on a few very heavy and expensive works, rather than on the wide extension of a railway system of comparatively light initial construction to develop new districts, open up the country to commerce and industries, and afford new lines of communication. Another reason for the unsatisfactory condition of the railway system of India appears to lie in the fact that military engineers are so largely employed in the railway service, while the entire railway system is practically under control of a military engineering board which involves a good deal of formality and red tape. This state of affairs is frequently declaimed against in the Indian papers. Army engineers, with government funds and resources behind them, are as a rule the least likely to be prompt to recognize and make use of the small details and opportunities which tend to economy in the construction and future operation of railways. It might be thought that with such a military element the strategic features of the railway system would at least be carried out, but the India Office in England, with its conventionalities and "red tape," blocks even this, and not only pigeonholes projects for frontier and other lines recommended by the military authorities as aids to the mobilization of troops and the extension of lines of communication, but has also continually postponed consideration and approval of the practicable and economical scheme to connect extensive isolated systems of meter gage railways by laying a third rail along broad gage lines which now connect them, but prevent through traffic (Eng. News, Oct. 24, 1891). It is now reported that this project is to be carried out, or at least a beginning made; but it has been absurdly long delayed. The Russian shadow is always on the Indian frontier, and it may be that England will one day have cause to regret its unsystematic and dilatory policy in regard to railways of military importance at least.

As to the building of frontier railways, it has been stated that on one of the recent lines so many mistakes were made and so much extravagant expense incurred, due largely to the system of government management, that it was almost a scandal outside of the circle of government authority. It is said that on this line the nominal maximum grade was 2.22% and the minimum curve 600 ft. radius, but as the grades were not compensated for curvature the indiscriminate combination of the two resulted in grades actually equivalent to 2.7%. Trains were frequently stalled on the grades. Though intended mainly for military purposes, the location of this line from a strategic point of view has been as much criticised as its construction. The management and operation of existing railways are also open to criticism, judging by frequent complaints in the Indian papers. We fully recognize that much meritorious work has been done by railway engineers in India, and that any sweeping condemnation giving no credit for such good work would be unjust; but the bad effects of conservatism in railway practice, both in construction, equipment and operation, are too evident to be overlooked.

The same conservatism, implying lack of power to grasp new economic conditions and adapt oneself thereto, has been very evident in Australia, some of the earliest railways (all built by the government) having been built in the most massive and costly style, as if for a trunk line with considerable traffic, and often with very costly work which was unnecessary for any sort of line, with better judgment in location. The development of these Australian colonies has been largely retarded by lack of railway communication, resulting from the construction of such needlessly expensive lines, rather than light lines adapted to the traffic, and susceptible of improvement with the growth of the traffic. Had a system of construction been adopted more in keeping with the requirements and the prospective traffic, there would probably now be three times as great a railway mileage, built at the same, or even less, cost, and far better adapted to the traffic, which even now is very light. It is also probable that more satisfactory results in many ways would have been obtained had the lines been built by private companies than by the governments. While some form of government supervision is always desirable, to insure safety and efficiency in operation, and to check excess of competition, government ownership of railways, with its lack of competition and its tendency to discourage new methods, is even less adapted to colonial conditions than to those in large and rich countries. The following extract from a letter recently received from a railway engineer in Queensland will illustrate this point:

This colony is in a very depressed condition, mainly through most extravagant expenditure upon railway construction of the English type which is utterly unsuited to the requirements of this young colony. There is a powerful clique here, who are wedded to the extravagantly costly English system, although that system, so largely applied here, has proved itself most ruinous, not only to the finances of the colony, but also to the farmers and others who are dependent upon the use of the railways, as the absurdly high tariffs preclude the possibility of farming to advantage at even 100 miles from the coast. Our Railway Commissioners have quite recently revised the tariff for the carriage of wheat and maize in five-ton loads, and although they claim to make a great concession, their rate for 100 miles is 12s. 5d. (about $3.10) per ton for a five-ton load, which is equivalent to 3.7 pence (7.4

cts.) per bushel for 100 miles, or 1½ pence (3 cts.) per ton per mile. On most of our country roads it is not possible for a farmer to haul so much as five tons in one load, and as demurrage is charged against freight cars, the concession only finds its way into the pockets of an agent, and not into those of the farmers.

In a paper on railway extension in the British colonies, read in 1886 by Mr. J. S. Jeans, Secretary of the Iron and Steel Institute, of England, it was justly stated that the immense development of trade in the United States during recent years had been largely due to railway extension. Assuming that a mile of railway contributed to the opening up of 20 square miles on each side, it was shown that the railways of the United States would be equal to the opening up of about 5,500,000 sq. miles, or nearly double the absolute area of the country, excluding Alaska. The following table shows the proportion of the area of different countries which would be opened up, on this basis, the figures being those of 1886:

	Equivalent area developed.	Proportion of total area.
United States	5,500,000 sq. miles.	double.
India	500,000 "	one-third
Canada	400,000 "	one-ninth
Australia	280,000 "	one-eleventh

The total mileage of railways in the colonies was then given as 30,000 miles, or one mile of railway to 7,379 persons and to 269 sq. miles of area. The United Kingdom had one mile of railway to 6½ sq. miles of area, and the United States one mile to 25 sq. miles. If the colonies had then had the same relation of railways to area as the United States, they would have had, according to Mr. Jeans, 330,000 miles of railway. It is true that a large part of the area of the colonies, especially the northern part of the Dominion of Canada, and perhaps the greater part of the interior of Australia, is incapable of improvement into a settled and civilized country, but even allowing that one-third of the whole colonial area is thus excluded from a fair comparison, the same computation would indicate that the colonies ought to have 220,000 miles of railway instead of 30,000.

The real truth of the matter, so far as can be judged by comparison with conditions in Britain and the United States, is that the colonial condition acts as a blight upon both the growth of population and of private enterprise. Great Britain has, apart from India, 7,225,709 sq. miles of colonial dependencies, divided up into 41 different colonies, of which 16 have over 20,000 sq. miles each of area. Not one of these colonies has increased very rapidly in population, after it had once attained to such a population that it took a considerable increase to show much percentage, and with possible exceptions which prove the rule not one of them has any railways constructed wholly or chiefly by private enterprise. The Canadian railways have all been heavily subsidized, and the Australian railways have nearly all been built by the government direct. Whether this is the direct result of the colonial condition or not is, of course, open to dispute. It appears to us that it is, and also that it is a natural result of a colonial status. No one would like to do business with children, or to give them command over his future welfare, and what is a colony but a confessed political child, not yet able or willing to stand alone, and hence not a responsible agent to trust to?

Be this as it may, in India and South Africa as well as Australia, the railways are mainly under government control. In the Australasian colonies the railways, as stated, are owned and operated by their respective governments (there are seven of them, for a total population of 3,776,000), the management being placed in the hands of railway commissioners. Victoria, however, which led the way in the adoption of the commission system of control, has within a year abandoned that system, and the management is again under the direct control of the parliament, and is said to be made use of for political purposes. Through a narrow-minded instinct of disunion, which perhaps is another effect of the colonial status, each colony adopted a gage of its own without reference to that of the others, and now that the railways have been built to form connecting lines there is no little trouble due to break of gage, and a commission has had under consideration the possibility of securing a uniform gage. The narrow gage idea is still believed in to a considerable extent in Australia, which in itself implies a backward condition of railway practice, but it is to be hoped that this folly at least will not prevail to perpetuate and increase existing difficulties. It is too late for us to discuss that question on its merits, but the all but complete abandonment of that panacea in this country, where we are accused of seeking low first cost at all hazards, ought to convince the Australians that there is nothing in it.

The following table gives some comparative figures relative to the railways of Great Britain, the British colonies and the United States, but as the financial items of the latter represent averages including both heavy and light construction, it must be remembered that it is much too high to represent the cost of railways built on the American plan for the light traffic which mainly exists in the colonies. It is also to be remembered that the nominal capital account of most American railways is from 50 to 100% greater than the actual cash cost of the line, which in England and the colonies is rarely the case.

	Queensland.	New South Wales.	Victoria.	South Australia.	New Zealand.	India.	Natal.	Canada.	United Kingdom.	United States.
Area, sq miles	668,224	309,175	87,884	903,425	104,235	1,378,044	19,000	3,510,500	121,115	2,967,617*
Population	393,938	1,145,400	1,137,272	328,000	623,000	234,490,000	481,362	5,000,000	38,000,000	62,622,250*
Population per sq. mile	0.6	4	13	0.36	6	170	25	1.4	314	21.1
Population per mile of railway	179	536	412	197	358	13,790	1,800	370	1,900	367
Miles of railway	2,195	2,183	2,763	1,666	1,842	16,996	268	13,256	20,073	170,601
Gage	ft. ins. 3 5	ft. ins. 4 8½	ft. ins. 5 3	ft. ins. 3 6 / 5 3	ft. ins. 3 6	ft. ins. 5 6 / 3 3⅜		ft. ins. 4 8½	ft. ins. 4 8½	ft. ins. 4 8½
Cost per mile	$31,400 cts.	$72,795 cts.	$65,765 cts.	$34,330 cts.	$38,760 ct .	$62,820 cts.	..... cts.	$59,250 cts.	$223,550 cts.	$59,820 cts.
Gross receipts per train mile, 1890-91	115.66	169.76	129.26	155.88	186.00	186.00	.....	112.30	117.22	135.60
Operating expenses per train mile, 1890-91	82.18	104.52	90.54	78.00	116.18	93.00	.....	86.80	63.64	93.43
Net revenue per train mile	33.48	65.24	38.76	77.28	69.82	93.00	.....	25.50	53.58	42.17
Percentage of operating, exp. to earnings.	71.05	61.57	70.05	49.0	62.47	49.87	60.0	70.0	53.8	68.8

* Exclusive of Alaska.

In no country in the world has the economical construction of railways been so systematically and thoroughly carried out as in the United States. It goes without saying that its rates for transportation are phenomenally low. In our issues of Feb. 13 to March 5, 1892, we gave very full abstracts from official statistics showing that in respect of safety to persons our railways are only fractionally, if at all, inferior to the British. Most of our principal trunk lines are well and safely built, have good bridges and structures, and a track equal to, if not superior to, that of European trunk lines, while signals, the block system, and safety appliances are becoming more and more general with the growing increase of the traffic. Railways in the undeveloped districts of the far west and south, etc., are built in accordance with the traffic they are expected to accommodate at the time of their completion, and as the traffic increases and financial circumstances permit these roads are pretty steadily improved by the construction of new bridges and buildings, heavier track, etc.

This is the main feature of American railway practice, progressive development as the requirements of traffic warrant, while that of English railway practice is to have but one style for all conditions, and that the costliest, because it has been handed down by tradition as the "proper thing." There has been some change lately, however. To some extent American ideas are now being followed. American types of bridge design are being introduced, though sometimes imitated very badly, with a not very clear perception of the principles involved. Flange or T rails are being more extensively used instead of the English double-head or bull-head rails, which involve so much unnecessary material and expense. Where the traffic is heavy, metal tie plates are sometimes used under the T rails, particularly in India, as noted in our issue of July 14, but in Australia many of the timbers used for ties are so hard as to render tie plates unnecessary (Eng. News, Oct. 31, 1891). English locomotive builders recognize the advantages of American engines and advertise engines of the American type for colonial and foreign railways, though these engines frequently embody no more "American" features than such accessories as cowcatchers, headlights, etc., and are almost never up to the originals in essential features. Still the introduction of American built locomotives into Australia, New Zealand, etc., and the growing tendency to adopt certain features of American design in European locomotive practice, and the successful results thereby obtained, seem to show that the advantages of American over English practice will be more and more generally recognized and eventually adopted in spite of the strong opposition and dense prejudice heretofore shown.

It is pretty certain that few English engineers, managers or superintendents of colonial or foreign railways are personally familiar with the features of railway practice which have made our own railway system so successful, but which they nevertheless not unfrequently undertake to criticise; and it would probably be greatly to the interests of commerce and development if the Indian and colonial governments were to obtain from capable men, familiar with both systems, reports on American practice in regard to the construction, equipment and operation of railways in thinly populated districts, as well as in thickly populated districts with heavy traffic.

The general features of English and American practice were compared in an article on "English and American Railways" in our issue of July 4, 1891, which was based upon observations made in both countries, and it was there pointed out that the central principle of American practice has been to build a railway at a low first cost to meet existing requirements and make some slight return, and then to improve it as traffic increases and the line becomes more prosperous. Of course in many cases the improvements have not kept pace with the traffic, owing to the desire to make as much money and avoid as much expenditure as possible. This, however, is not economy, and these are exceptions which do not affect the principle. When properly carried out it is the only right principle for the economical (not cheap) construction and operation of railways, for the interests of the railway companies, the traders, and the community at large alike. Until India and the Australian colonies awake to this fact their material interests will suffer grievously and needlessly.

The proposed ship railway from Collingwood, Georgian Bay, on Lake Huron, to Toronto, on Lake Ontario, will be about 66 miles in length. It is intended to have three standard gage tracks, laid with 110-lb. rails, and to transport vessels of 1,000 tons register, or about 2,000 tons displacement and 14 ft. draft. The estimated cost is $15,500,000. The maximum grades will be 0.62%, while the majority of the line will be on a grade of about 0.23%. The summit is 670 ft. above the level of Lake Ontario. There will be two or three hydraulic floating turntables, curves being inadmissible. Mr. E. L. Corthell, of Chicago, is the engineer, and the system is similar to that proposed by the late Capt. Eads for the Tehuantepec ship railway, and adopted for the Chigneto ship railway. The Ontario Ship Railway Co.'s line will save about 300 miles of navigation through St. Clair River, Lake Erie and Welland Canal. Mr. David Blair, of Toronto, is manager of the new company.

The officials of the city of Newark have paid the East Jersey Water Co., $3,500,000 for the water supply plant recently put in operation, but have retained $500,000 of the amount due which they propose to hold until the company makes good the defects pointed out by the city's engineers, Messrs. Fteley and Jacobsen, as given in their report in our issue of Feb. 27 last.

The Judson Pneumatic Co. has obtained permission from the New York Board of Aldermen to test its pneumatic street car motor on the Twenty-eighth and Twenty-ninth St. Ry. The company has abandoned its ingenious but rather impracticable "threadless screw" method of traction, described in our issue of July 13, 1889, and has adopted a compressed air motor resembling to some extent the Mekarski, which has been so successful in France (Eng. News, May 24 and 31, 1890.)

LETTERS TO THE EDITOR.

THE MANNESMANN PROCESS.

Sir: Can you inform me if the Mannesmann process for manufacturing seamless steel tubes has been established in this country. Yours truly,

Frederick W. Frost.

New York, July 25, 1892.

(Not to our knowledge.—Ed.)

TEST RECORDS OF THE LESS KNOWN CEMENTS.

Sir: Can you refer me to any publication in which tests and relative values of the less known cements, commonly used in America, are given? I do not refer to Portland or Rosendale, but to those less extensively known. Very respectfully,

H. H. F.,

Atlanta, Ga., July 27, 1892.

(Such records of tests are scattered through the back files of this journal and other repositories of engineering literature, but it is risky business trusting to them, as the qualities of the less known brands may change greatly from year to year, or for that matter even from hour to hour. The only proper method in carrying on works where the strength of the cement is a matter of importance is to systematically test samples of the cement as fast as received.—Ed.)

THE LARIMER COLUMN.

Sir: The so-called "Larimer" column, illustrated in your number of July 28, 1892, appears to be an example of how "history sometimes repeats itself," especially in the U. S. Patent Office. Sometime in the fall of 1873, Mr. Charles Kellogg, Jr., Buffalo, showed me a model of a column of just that section, on which he told me he had secured a patent. It was advertised in some of the engineering papers with a cut and I am very sure as a patented column. It appears to have undergone the regenerative influence of a new birth. Truly yours, L. L. Buck.

(There is one point of difference, however. The Larimer column has come into quite extensive use, whereas we infer from our correspondent's letter and our own recollections that the Kellogg original was not very actively pushed, and did not come into use at that time to any extent. Perhaps the change in manufacturing conditions explains the contrast.—Ed.)

THE STEARNS BRIDGE TRUSS.

Sir: It seems to me that the following criticisms are pertinent in respect to the Stearns truss, as illustrated in edition of July 21: That, by reducing the total length of compressed members in a bridge, considerable economy in weight is possible, seems evident; it is, however, not sure that such an economy is really attained by Stearns truss as illustrated, without considerably reducing the safety of the bridge. No dimensions being given on the drawing, it is not possible to ascertain whether the exceeding height of the top-chord is not a great drawback, adding considerably to the strain in the same.

The top-chord, which is shown riveted together in one piece from one end of the bridge to the other, suffers additional strains, not so much from its own weight between the panel-points, at ordinary intervals, as from the deformation of the angles due to the bending of the bridge, whenever it is loaded.

The method to carry the top-chord as one piece throughout the bridge is a dangerous one, if the secondary moments occurring in the same are not duly considered, because the additional strains caused thereby may amount to one-third of the ordinary computed diagram strains. They ought to be either avoided by a suitable construction, or be taken in consideration. Very respectfully, Charles Steiner.

Minneapolis, Minn., July 25, 1892.

HOW THE "CITY OF PARIS" MADE HER TIME.

Sir: It may be of interest to your readers to know that the recent record made by the "City of Paris," as noted in your last issue, was made possible by an improvement which has just been made by the house of Henry R. Worthington, of this city. I refer to the addition of a feed water heater recently invented by Mr. C. C. Worthington, of New York, and supplied to the "City of Paris" as well as the "City of New York."

They have had one of these heaters in use for two or three voyages, but this is the first westward trip where there has been one in use in each engine room. The arrangement as shown by the accompanying blue prints is that of a cast iron cylinder into which the feed water is delivered by an independent pump. It enters by an upturning nozzle and mingles with steam admitted in a peculiar manner by means of a perforated cylindrical plate. Steam is derived from the exhaust of the auxiliary engines, which is collected by a pipe running throughout the ship, into which discharge some 50 or 60 small engines, such as those used for driving the ice machines, dynamos, feed pumps, bilge pumps, circulating pumps, hoisting engines, etc.

The water is taken from the heater and fed to the boiler by another independent pump. The speed of this pump is controlled by a float so that it will stop and start automatically, depending upon the amount of water admitted to the heater. The auxiliary exhaust pipe also leads to the receiver between the intermediate and low pressure cylinder of main engine.

It is found in practice that the valve on this connection can be left wide open, as well as the valve leading to the heater, because a sufficient quantity of steam is taken up by the heater without special attention.

The pressure carried on the heater is about 15 lbs. per sq. in., and the temperature of the feed water is raised to from 200° to 220° Fahr. This not only adds greatly to the steam power of the boilers, but serves to reduce the strain upon them which would be caused by wide differences of temperature.

Very truly yours, E. H. Foster.

New York, July 30, 1892.

PUMPING HOT WATER.

Sir: Is it a fact that the appliance known as the "steam siphon" will not operate in hot water? If this is so, please explain through the columns of the News the reason for it; also please inform me as to what is the lowest temperature in which it will operate. Why does not the stream of cold water coming in contact with the steam condense it and cause the atmosphere to force the water back, thus filling the partial vacuum occasioned by the condensation?

H. F.

Birmingham, Ala., July 11, 1892.

(The "steam siphon," to which our correspondent probably refers is not properly a siphon at all. True siphons started into action by a steam jet may be and doubtless have been constructed, but what is more commonly known as the "steam siphon" is also and more properly called an ejector or steam jet pump, and these names correctly indicate its action.

Like any other pump, the ejector cannot lift hot water to as great a height as it can cold water. The reason for this is that as the pump reduces the pressure on the column of liquid in the suction pipe, it lowers at the same time its boiling point. If the reduction of pressure be great enough, the boiling point may fall to or below the temperature of the water in the suction pipe; and when this happens the water gives off steam which fills the space caused by the upward motion of the piston and leaves the water stationary. Evidently the hotter the water to be pumped the less the possible lift, and this is true whatever type of pump is used. The limits of temperature vary, depending chiefly on the lift and on the mechanical construction.

There is, however, an additional reason why the steam ejector will not operate in hot water. It is necessary to the successful operation of every form of apparatus for pumping liquid by a steam jet that the steam should be condensed at a certain point in its flow, otherwise the pipe may be filled with a mixture of steam and water, and the steam may even flow back into the suction pipe.

For this reason steam jet pumps work at a higher duty as the temperature of the water which they handle decreases. If the water to be pumped is at a temperature too high to condense the steam from the jet, the pump may refuse to work at all. We believe, however, that some makers of steam jet pumps supply a special form of pump for handling hot liquids in which a small auxiliary stream of cold water is used to condense the steam at the proper point.—Ed.)

SPECIFICATIONS FOR STRUCTURAL IRON AND STEEL.

Sir: Having lately seen several cases in which specifications for structural iron or steel were modified during manufacture at the request of the manufacturer, I beg the privilege of your columns to make an earnest protest against the practice.

Such a case usually occurs thus: The manufacturer finds that some iron which he has rolled to fill the order of a certain engineer gives tests outside the prescribed limits. It may not be poor material; on the contrary, it may show first-rate tests, only it is not what is called for. Perhaps it has been cut to length before the tests were made. At any rate, the maker resolves to secure its acceptance if he can.

He therefore talks to the inspector in the sophistical manner common to iron manufacturers, his usual ground being that if the inspector is satisfied of the fitness of the iron for the purpose intended he would be very unreasonable to reject it on a mere technicality of 2,000 or 3,000 lbs. of elastic limit, or whatever it may be. The inspector probably says he is not paid to satisfy himself, but to see that the material conforms to specification, in reply to which it is politely implied that he is an inexperienced crank.

Failing in the effort to talk the inspector into accepting the material, the manufacturer may write to the inspection bureau, if there is one, but as they are apt to take the same "unreasonable" view as their employee, he eventually writes a smooth letter to the engineer, explaining how the iron was finished a little too hot, or too cold, or did not get quite enough work, or something else, but is undoubtedly the very grade that he wants, although it does not quite give the test. Will he therefore kindly accept it in this case?

The trouble is that the engineer sometimes does, and it is a bad thing all around.

He secures for his own future orders poorer material, because as soon as the manufacturers learn that he is that kind of a man, "not particular," they do not take the pains in making his iron, and the inspector will not be as rigid if he finds that the engineer is going to accept iron after he has refused to.

It is not fair to the iron manufacturers, because a man who bids on an order, expecting to have his first rollings accepted anyhow, will bid a little lower than one who expects to furnish the material just as specified. It is not fair to the inspectors to thus sit on their decisions when they are consistent and carry out their instructions.

If the engineer is not particular about his material, it will be fairer to others and secure him better service to write an easy specification and enforce it strictly, than to write a hard one and then disregard it. Is it not so? Very respectfully yours.

George F. D. Trask, E. M.

Philadelphia, Pa., July 27, 1892.

(It is so.—Ed.)

NOTES AND QUERIES.

C. F. D. asks: What is the cause of gas jumping up and down, also remedy for same? Some say water in the pipes, but the pipes have been pumped, and the old trouble returns. The meter has also been changed without any effect.

The cause of gas jets jumping up and down is variation of pressure, and the remedy is to remove the cause of these variations, whatever they may be. Most commonly, as stated above, the cause is either the meter or liquid in the pipes, sometimes water and sometimes liquid hydrocarbons. The gas company's engineer should be able to locate the difficulty. If the jumping is rapid and serious enough to be worth some trouble and expense to remedy, it might be well to try placing a gas tight chamber of several cubic feet capacity on the pipe supplying the building. If made large enough this will act as a reservoir and will steady the pressure on the burners sufficiently to stop the jumping. A good gas regulator might save all the trouble and also some of the gas bill.

THE ENGINEERING SCHOOLS OF THE UNITED STATES.

XVI.

(These articles will be republished in book form and proper corrections are requested and can be made at any time. It is especially requested that any errors of omission or commission in the statistics of this and following articles may be promptly reported to us. Any college which ought to be included in Tables XIII. and XIV., but is not, will be included if the necessary facts are sent to us. Returns of number of graduates should be for civil, mechanical, mining and electrical, separately.)

THE DEMAND AND SUPPLY OF ENGINEERS.

Practically speaking, the recruitment of the profession of engineering from graduates of technical schools did not begin until after the civil war. Prior to 1866, six schools only existed, and the number of their graduates was very small, as will be seen from the large Table XIV. herewith.

Since that date the enormous expansion which is in part indicated by Table XIV. and the accompanying diagram has taken place. We say "in part" because, although Table XIV. gives the total number of graduates from 52 different engineering schools, including all the leading schools, yet this is somewhat less than half the total number of schools which now purport to educate engineers, and most of which are strenuously endeavoring to increase the quantity and quality of their instruction so as to place themselves fully abreast with the average engineering school, if not in the first rank.

Many new schools, especially, which are not repre-

TABLE XIV. TOTAL NUMBER OF GRADUATES FROM COURSES IN ENGINEERING ONLY FROM 52 ENGINEERING SCHOOLS OF THE UNITED STATES; FOR EACH YEAR FROM THE FOUNDATION OF THE SCHOOLS TO 1892.

(EXCEPT THAT PRIOR TO 1880 THE NUMBER OF GRADUATES IN EACH **FIFTH** YEAR ONLY IS GIVEN.) NUMBERS IN (PARENTHESES) ARE ESTIMATED OR DOUBTFUL. SEE NOTES BELOW.
(PROMPT CORRECTION OF ANY ERROR HEREIN IS REQUESTED.)

School:	1810	1845	1850	1855	1860	1861	1862	1863	1864	1865	1866	1867	1868	1869	1870	1871	1872	1873	1874	1875	1876	1877	1878	1879	1880	1881	1882	1883	1884	1885	1886	1887	1888	1889	1890	1891	1892	Total since 1859	School:
1. Rensselaer	13	6	7	6	18	18	9	12	6	12	17	25	22	20	20	26	17	21	11	24	32	27	33	31	18	20	18	15	22	32	48	42	30	18	20	31	33	748	1. Rensselaer.
2. Harvard	....	....	....	4	3	4	6	5	5	13	1	3	5	5	3	2	....	5	4	2	4	10	....	....	2	1	1	....	1	4	....	....	4	....	4	4	1	102	2. Harvard.
3. Yale	(See note.)	2	3	2	2	3	4	3	6	5	....	10	7	10	11	8	12	13	16	18	15	14	13	19	18	17	19	22	32	33	31	35	39	33	44	74	608	3. Yale.
4. Dartmouth	....	....	....	2	....	3	4	2	1	2	2	4	6	4	7	6	2	9	13	6	5	7	5	10	6	9	3	8	7	11	6	9	10	5	11	5	8	198	4. Dartmouth.
5. Union College	....	....	3	3	6	9	6	2	7	4	9	12	9	8	6	6	4	5	13	14	12	13	2	3	7	4	7	6	11	9	8	6	4	4	5	5	10	236	5. Union Coll.
6. University of Michigan	....	....	....	....	2	3	1	5	1	6	7	8	17	17	15	17	11	11	14	20	11	6	18	8	7	9	3	7	5	7	13	17	21	19	20	17	22	365	6. University of Michigan
Totals, Group A	13	6	12	18	31	39	29	30	23	45	41	52	59	61	61	68	42	63	68	82	82	78	72	65	59	61	49	55	68	95	103	105	104	85	93	126	148	2,257	Totals, Group A.
7. Brooklyn Pol. Inst	....	....	....	....	....	....	....	....	....	....	4	4	5	4	4	7	2	3	6	9	8	10	4	6	3	8	5	4	7	2	7	7	8	7	7	(5)	5	151	7. Brooklyn Pol. Inst.
8. Penna. Mil. Ac.	....	....	....	....	....	....	....	....	....	....	....	3	5	3	8	7	12	9	3	18	8	10	8	15	13	19	9	7	14	13	10	14	11	11	16	8	5	259	8. Penna. Mil. Ac.
9. Columbia	....	....	....	....	....	....	....	....	....	....	..	14	21	12	9	6	4	5	8	15	21	30	29	25	23	23	24	27	45	41	24	34	19	29	30	43	60	621	9. Columbia.
10. Wash. & Lee	....	....	....	....	....	....	....	....	....	....	....	....	2	6	1	2	3	8	5	10	2	2	2	....	1	....	2	....	....	....	2	2	2	1	....	....	4	57	10. Wash. & Lee.
11. Mass. Inst. Tech.	....	....	....	....	....	....	....	....	....	....	13	4	8	15	9	17	15	22	29	23	12	17	6	14	12	15	24	20	49	43	37	60	73	70	92	722	11. Mass. Inst. Tech.
12. Lehigh	....	....	....	....	....	....	....	....	....	....	....	....	....	2	5	4	7	3	5	7	11	8	10	4	7	2	8	19	16	14	21	32	51	31	36	36	38	377	12. Lehigh.
13. Univ. of Va	....	....	....	....	....	....	....	....	....	....	....	....	....	4	....	2	2	3	3	2	2	3	....	....	....	1	3	1	1	....	3	....	2	5	3	3	4	47	13. Univ. of Va.
14. Cornell Coll., C. E.	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1	7	16	18	23	9	14	17	16	12	7	11	4	12	9	9	11	17	21	14	15	52	79	394	14. Cornell Coll., C. E.
Totals, Group B	....	....	....	....	....	....	....	....	....	....	4	21	46	35	36	50	55	66	68	92	95	106	81	79	69	78	67	85	116	99	127	149	171	158	180	217	287	2,628	Totals, Group B.
15. Tufts	....	....	....	....	....	....	....	....	....	....	....	....	....	....	2	1	....	4	2	2	3	1	4	5	3	3	....	3	1	2	4	9	8	4	9	(9)	12	91	15. Tufts.
16. Univ. Ga	....	....	....	....	....	....	....	....	....	....	....	....	....	....	2	5	5	4	7	2	5	4	2	1	2	1	3	7	3	3	7	3	6	4	6	3	4	89	16. Univ. of Ga.
17. Lafayette	....	....	....	....	....	....	....	....	....	....	....	....	....	....	2	5	5	8	11	7	16	15	6	4	7	2	3	7	12	8	7	7	6	4	11	(7)	7	167	17. Lafayette.
18. Washington U.	....	....	....	....	....	....	....	....	....	....	....	....	....	....	2	3	3	3	6	5	3	4	4	6	2	9	4	4	9	3	4	11	8	3	6	3	9	114	18 Washington U.
19. Univ. of Vt	....	....	....	....	....	....	....	....	....	....	....	....	....	....	2	2	2	4	3	3	1	3	1	1	2	1	4	1	2	5	8	5	4	3	5	6	4	72	19. Univ. of Vt.
20. Kans. Agr. C.	(See note.)	....	....	....	....	....	....	....	....	....	....	....	....	....	(4)	(2)	(1)	(4)	(1)	(4)	(6)	(3)	(6)	(5)	(6)	(5)	(8)	(12)	(10)	(14)	(14)	(15)	(17)	(18)	(26)	(20)	202	20. Kans. Agr. C.
21. Worces. Poly. Inst	....	....	....	....	....	....	....	....	....	....	....	....	....	....	10	12	16	16	18	17	19	13	20	13	16	24	18	20	24	27	21	28	27	27	26	32	444	21. Worces. Poly. Inst.
22. Ala. Polyt. Inst	(See note.)	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1	....	1	1	1	3	7	4	9	5	4	3	3	4	2	3	7	12	8	....	6	84	22. Ala. Polyt. Inst
23. Me. Agr. Col	....	....	....	....	....	....	....	....	....	....	....	....	....	....	4	4	10	12	12	9	5	11	3	12	10	6	6	9	13	14	12	6	26	14	17	215	23. Me. Agr. Col.
24. Iowa Agr. Col	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	2	....	4	5	1	5	3	....	4	1	4	9	6	4	5	3	5	6	14	18	99	24. Iowa Agr. Col.
Totals, Group C	....	....	....	....	....	....	....	....	....	....	....	....	....	....	10	30	34	46	60	55	67	65	50	61	46	59	59	61	77	74	93	92	97	85	122	108	129	1,577	Totals, Group C.
25. Univ. of Penna.	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	2	9	6	8	3	6	5	8	10	5	8	14	5	14	14	15	9	9	16	7	173	25. Univ. of Penna.
26. Stevens Inst. Tech	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1	3	9	16	9	22	15	6	16	12	19	40	36	32	30	38	36	39	45	39	463	26. Stevens Inst Tech.
27. Univ. of Wisc	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	3	1	3	4	5	1	1	5	6	6	8	9	13	6	8	8	9	8	15	15	134	27. Univ. of Wisc.
28. Dartmouth, Thayer	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	2	2	3	2	4	1	3	2	2	2	3	2	1	4	4	3	2	6	4	2	52	28. Dartmouth, Thayer.
29. Swarthmore	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	2	5	4	1	4	3	2	2	1	5	3	1	3	4	10	6	5	6	7	74	29. Swarthmore.
30. Cornell Coll., M. E.	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	3	3	4	2	5	5	5	5	6	7	10	7	10	19	24	33	60	52	79	339	30. Cornell Coll. M. E.
31. Univ. of Mo.	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	3	2	5	3	4	2	2	2	5	1	5	3	3	4	....	....	1	4	3	49	31. Univ. of Mo.
32. Univ. of Cal	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	8	8	11	12	5	23	8	9	9	5	7	5	3	14	5	9	10	17	14	182	32. Univ. of Cal.
33. Univ. of Kans.	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1	....	1	....	....	....	1	1	....	2	2	1	2	1	6	3	6	1	4	32	33. Univ. of Kans.
34. Univ. of Minn.	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	3	3	....	1	2	....	....	....	....	3	4	4	....	2	3	1	12	7	8	53	34. Univ. of Minn.
35. Rutgers	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	11	2	13	7	7	3	9	5	2	8	6	10	8	6	8	8	13	10	136	35. Rutgers.
36. Univ. of Iowa	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	3	....	....	3	2	3	4	4	2	7	5	1	2	6	9	5	59	36. Univ. of Iowa.
37. Cornell Col., Ia	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	2	1	3	2	3	3	1	2	3	2	1	8	4	8	8	1	9	61	37. Cornell Coll., Iowa.
38. Univ. of Ill	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	9	5	5	4	7	5	7	9	9	10	6	4	20	19	15	134	38. Univ. of Ill.
39. Univ. of Cinc.	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	2	5	1	2	3	1	1	....	....	1	1	1	3	4	3	28	39. Univ. of Cinc.
40. Princeton	(See note.)	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	(5)	(5)	(5)	(5)	(5)	(5)	(5)	(5)	(5)	(5)	(5)	(3)	(5)	76	40. Princeton.
Totals, Group D	....	....	....	....	....	....	....	....	....	....	....	....	....	....	8	31	54	64	54	78	83	59	78	70	80	124	100	107	137	135	136	206	216	225	2,045	Totals, Group D.
41. Texas Agr. Col	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	2	....	....	....	....	....	....	....	9	13	7	12	19	62	41. Texas Agr. Col.
42. Univ. of Neb.	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1	....	1	3	....	....	1	1	3	2	2	5	19	42. Univ. of Neb.
43. Colo. Sch. of M.	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1	1	....	1	4	....	7	2	2	2	9	29	43. Colo. Sch. of M.
44. W. Univ. of Pa.	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1	1	4	2	3	4	1	4	7	14	41	44. W. Univ. of Pa.
45. Pa. State Coll.	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1	....	....	1	1	5	10	10	15	43	45. Pa. State Coll.
46. Purdue	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	2	5	1	9	13	7	16	22	75	46. Purdue.
47. Rose Poly. Inst.	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	16	8	11	8	14	17	25	99	47. Rose Poly. Inst.
48. Univ. of Tex	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1	2	1	2	6	12	48. Univ. of Tex.
49. Mich. Min. Sch.	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	7	6	7	3	3	26	49. Mich. Min. Sch.
50. Mich. Agr. Coll.	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	3	6	9	6	7	31	50. Mich. Agr. Coll.
51. Ga. Sch. of Tech.	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	2	10	20	32	51. Ga. Sch. of Tech.
52. Montana Sch. M.	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	2	(4)	6	52. Montana Sch. M.
Totals, Group E	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	2	1	1	3	5	7	27	14	53	59	65	89	149	475	Totals, Group E.
Grand totals	13	6	12	18	31	39	29	30	23	45	45	73	115	96	107	148	131	183	227	283	308	303	281	288	226	277	246	284	390	375	459	497	560	523	668	756	938	8,982	Grand totals.

sented at all in our table, have large foundations and able management, and are likely to rank with our very best schools ten years hence. Prominent examples which occur to us are the Case School of Applied Science, at Cleveland, the new Chicago University and the new Leland Stanford, Jr., University, of California.

On the other hand, the 52 colleges from which we have detailed reports of number of graduates, etc., and which we have also deemed worthy of including in our table as having engineering courses properly so called, include a few schools (three to five in all) which were admitted to the list with some doubt, as possibly not giving sufficiently thorough instruction in engineering to entitle them to be classed in with the rest. Nothing can be told by the form of the degree, because many of our finest and largest schools very properly refuse to give their graduates any other degree than B. S. or Ph. B. unless they take a post-graduate course. As we have already shown, the total number of graduates bearing these degrees (which necessarily imply only a general course of study in some scientific branches) is several times larger than the number of graduates from engineering courses, and 200 or more colleges grant these degrees from courses in general science which do not profess to be engineering schools in any sense.

Obviously it is a difficult and delicate matter to draw the line between all these colleges, and impossible to draw it accurately, except as it is drawn by the colleges themselves. In two instances where it was certain that all the graduates of a school could not be classed as graduates in engineering and yet equally certain that some of them should be so classed, an arbitrary proportion of the number of graduates reported for each year has been taken as the proper number to include in Table XIV. These instances are both specified in notes appended to the table, and do not seriously affect the totals either way.

In no case (so far as we recall) do the figures in Table XIV. give the total number of graduates from any school. All have general courses in science, or in chemistry, geology and the like, which end in the conferring of scientific degrees, but which are not engineering courses. All such graduates have been carefully excluded from the table.

In the main, therefore, the large Table XIV. may be considered without essential error as accurately representing the total number of graduates from engineering courses from all the engineering colleges of the United States, the few graduates from schools not listed which ought to be included being approximately balanced by the few graduates from minor schools included in the table, and yet hardly to be classed with the rest as having received a proper engineering education. If anything, the totals of the table err by omission rather than by excess, we believe.

A mere glance at the table will show how astounding is the change which has taken place in the brief space of 30 years. Considering aggregates only, there were graduated from engineering courses:

		No.	Incr.	Incr., p. c.
In	1860	31	...	...
"	1865	45	14	42
"	1870	107	62	138
"	1875	283	176	164½
"	1880	226	–57	–20
"	1885	375	149	66
"	1890	666	291	77½
"	1892	938	272	41

The total increase alone in the two years since 1890 lacks only four of being as great as the total number graduated in 1882, and is nearly double as many as were graduated in 1886 (459), which latter was at the time a phenomenal jump above all previous records. To make this rapid growth in numbers more easily understood we reproduce the figures for each year arranged as in logarithmic tables:

1840.....	13	...	...	...	...	16	...	...	...	...	...
1850.....	12	...	...	...	...	18	...	...	...	...	...
1860.....	31	39	29	30	23	45	45	73	115	96	
1870.....	107	148	131	183	227	283	308	303	281	288	
1880.....	226	277	246	284	390	375	459	497	500	523	
1890.....	666	754	938	...	...	...	...	...	...	...	

As will be seen from the diagram printed below the total number of graduates from our civil engineering schools did not equal the number graduated yearly from West Point until 1867, at which date only the number of graduates in mechanical and mining engineering began to be considerable. Not until after 1881 did the total number of such graduates begin to exceed half of the "civil" graduates. Electrical engineering is a very recent innovation, which bids fair soon to become the largest department of all. Nearly half of the mechanical students now take the electrical course, and the aggregate of mechanical and electrical graduates now considerably exceeds the "civils." In a few years more the electrical engineers alone bid fair to outnumber the civils or regular mechanicals.

It will be seen by a mere glance at Table XIV. that the phenomenal growth in the total of graduates has been attained (1) by a pretty steady increase in the number of graduates from each school (with the one pitiful exception of the Lawrence Scientific School), and (2) by an equally steady increase in the number of schools. Hardly a year has elapsed since 1865 which has not seen the graduates of some new school coming in to swell the list. To facilitate comparisons we have (1) arranged the colleges in order of dates of first graduates, and (2) subdivided them into five groups (A to E) of approximately equal aggregate numbers of graduates and of approximately equal size; Group A consisting of the six oldest schools and Group E of the twelve youngest.

While these groups were formed quite at random, and long before it was known what the totals of each would be, it will be seen from the accompanying diagram that the several groups show a remarkable similarity in their fluctuations from year to year, indicating that the same external causes have affected them all. For example, the totals of Group B and Group D, though both of them sharply fluctuate, are almost identical for the decade between the classes of 1878 and 1888, and the same general similarity of form obtains throughout the diagram.

A very brief study of the fluctuations in comparison with the known state of the "times" will show that business conditions affect chiefly the size of the class which enters college rather than of the class which graduates. We have therefore added along the base of the diagram, above the large figures giving date of graduation, smaller figures for a date four years earlier showing the year when (with few exceptions) the graduating class of each year entered college. Thus it will be seen that the classes entering college in 1860, 1868, 1876–8 (especially) and 1885 were exceptionally small in each group, and were followed by rapid growth thereafter. These were periods of commercial depression, the profound and persistent depression which followed the panic of 1873, and was not fully ended until after 1880, being still a painful memory of many engineers. It

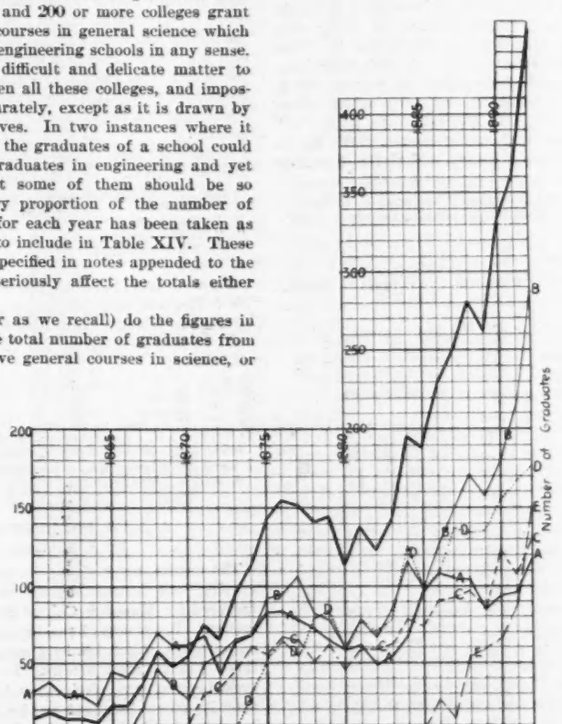


Diagram Showing Total Number of Graduates from All the Engineering Schools of the United States, and the Totals for Five Different Groups Separately for Each Year from 1860 to 1892, Inclusive

The heavy black line shows HALF the total number of graduates each year.
The line marked A shows the total of graduates from the group of six oldest colleges, as per tables XIII. and XIV.; the other lines, B, C, D, E, show totals for the corresponding groups of younger colleges in tables XIII. and XIV., group E being the youngest of all.
The large figures at the base of the diagram show the year of graduation. The smaller figures above them show the year when each graduating class entered college, assuming the course to be four years long, as in general it is, though some of the colleges have three year or even two-year courses.
Post-graduate degrees are not included in this diagram or in table XIV.

NOTES TO TABLE XIV.

PROMPT CORRECTIONS of any errors in this table, including notes for the addition to the list of any college which ought to be included but is not, are especially requested. Simple as it may appear, the compilation of the information in this table has been a matter of no little difficulty, and besides the many corrections which have been made, others probably should be made. The following notes refer to some known cases of antiquity or doubt.

YALE.—The Sheffield Scientific School has only a three-year course and grants to all its graduates the degree of Ph. B. only, giving professional degrees of C. E., etc., only after two years' post graduate study, or one year's study and one year's practice. The total number of Ph. B.s graduated in each of the last four years has been as follows:

	1889.	1890.	1891.	1892.
	70	62	64	74
Of which in	C. E. course.....	14	25	
	M. E. course.....	35	34	
	Electric course....	15	15	

For some reason which we do not fully understand the number of engineering graduates reported to us in 1889 and 1890 was considerably less than the above, being only 39 and 33 respectively, and proportionately for earlier years. We infer that this had resulted from there being some informal sub-classification of these Ph. B.s into engineers and non-engineers, which has not been continued in our reports of totals for 1891 and 1892, which latter were gathered separately, after the returns for 1890 and previous years had been collected. As the nearest approximation within our power we have given the figures as reported to us, making a sharp jump from 1890 to 1891, as follows:

	1889.	1890.	1891.	1892.
No. of Ph. B. graduates.....	70	62	64	74
Of which reported as engineers	39	33	all	all

If this is wrong, we shall be pleased to correct the error on being advised of it. Yale was the only college in the country which did not furnish us the totals of its graduates in each year officially. In default of other means of obtaining the information, a former graduate of the Scientific School undertook to compile it for us, and we necessarily assume that he has done so correctly until otherwise advised.

PRINCETON (College of New Jersey).—It was not possible to obtain any further information about the number of graduates in engineering, after many inquiries, than that there had been 76 in all between 1878 and 1892 inclusive, and 5 in 1892. Rather than leave these 76 graduates out altogether, they were divided equally between the 15 years in question, giving the odd one to 1891.

ALABAMA POLYTECHNIC INSTITUTE.—The total number of graduates is much larger than is here reported. For example, in 1892 there were 26 graduates, of whom only 6 are classed as engineers, and in 1891 there were 12 graduates, of whom none are classed as engineers.

KANSAS STATE AGRICULTURAL COLLEGE.—The figures given are two-thirds of the total number of graduates. The number of true engineering graduates is doubtless considerably less.

knocked the colleges out of their normal rate of growth for at least ten years. That the general condition of business greatly affects the sizes of the classes entering all the colleges, both new and old, may be clearly seen by following the diagram through in detail in this way, year by year. The enormous graduating classes of 1892 reflect the commercial conditions of 1888, which was a year of very great general prosperity. Reasoning by analogy, we shall expect to see a decided dropping off two or three years hence, to reflect the comparatively unfavorable conditions of 1891-'92, though nothing like as tremendous a loss as occurred after the panic of 1873.

We shall give later separate diagrams for some of the larger single schools, which naturally show some interesting contrasts. Of course the reader should be constantly on his guard against the grave error of regarding the comparative growth in numbers as anything more than a very rude index of the comparative excellence of the several schools. In one sense it is a safe index; a school will rarely increase very rapidly unless it is one of special merit; but many schools are, for a time at least, cut off from rapid growth by lack of funds to provide for it, and there are still others which seem to lack that enterprising spirit which pushes a school forward to numerical prominence, but which yet give most excellent instruction. Of averages this is less true. In the main, those schools which are attended by the largest numbers are those which have the most stringent requirements for admission and exact the most work from their students.

To illustrate how seriously misleading the mere number of reported graduates may be, if other attending circumstances be not known and kept in mind, we may quote the following explanatory letter from Prof. M. E. Wadsworth, director of the Michigan Mining School, giving some interesting information about that school:

> The number of graduates I reported would indicate, on the face, that the Mining School was diminishing in effectiveness, on account of having a diminishing number of students to graduate. This apparent diminution is owing to two causes: 1, The class which graduated in 1891 and that which is to graduate in 1892, entered at a time when our building was unfinished and unfurnished, and when the course was changed from two to three years. This frightened away a great many students, so that our entering classes were smaller. 2. We have been very much more rigid with regard to graduation within the past three years than previously. The number of students that we expect to graduate in 1893 is twelve. This is the first class to graduate who entered after our present status was thoroughly established. This year we have 75 pupils enrolled in mining engineering. It is our intention in 1893 to introduce a four years' course in connection with our present three years' course. The two courses will be arranged so that the student can graduate with the degree of Bachelor of Science after taking three years of mining engineering work, which will enable him to do the ordinary work of a mining engineer. The fourth year will be given to the more advanced and higher work, and will lead to the degree of Mining Engineer.

The 52 schools whose graduates are given in Table XIV. are those with which we shall be chiefly concerned in the investigations to follow, and in Table XIII. we give their formal titles in full, their location, and (at the end of the table) the courses which they have now established and from which there have been graduates. In the table the letter "C" stands for a civil engineering course, "M" for a mechanical engineering course, "Mn" for a mining engineering course and "El" for an electrical engineering course. In preparing this part of the table courses which formerly existed but have since been dropped are not included. For example, the Rensselaer Polytechnic Institute once had a course in mechanical engineering, but has since abandoned it, preferring to remain a purely civil engineering college. On the other hand, courses from which there have been no graduates reported, whether from lack of time since their establishment or otherwise, are not included in the table. It was not possible to do otherwise and represent facts, as a number of colleges have for years announced courses which have never yet borne fruit in graduates. Several flourishing electrical courses of two or three years' standing which have no graduates to their credit only because so newly established are known to exist which are not recorded in Table XIII.

It is evident at a glance from Table XIII. that the favorite method of establishing engineering schools is as branches of universities rather than as independent colleges. Of the 52 schools listed not less than 41 are departments of colleges or universities, and only 11 independent organizations. The average quality of the independent schools, however, is very much higher than the average of the university schools. Fair matches for Troy, Stevens and the Massachusetts Institute of Technology may be named from the university schools, but if it were attempted to mention four times as many, as numerical proportion requires, the average would fall materially.

Geographically, the 52 schools listed are distributed as follows:

In the New England States		9	
" " Middle	"	16	
" " Southern	"	8	
" " North Central	"	9	
" " Tr.-Mississippi	"	10	52

Texas is included with the Southern states. The New England and Middle states' schools average considerably larger than those in other sections.

In respect to courses, the 52 schools are divided as follows:

45 have C. E. courses, 7 have none.
31 " M. E. " 21 " "
18 " Mining " 34 " "
23 " Elec. Eng. " 29 " "
10 have C. E. courses only; 3, M E. only; 2, Mining only, none electrical courses only.
7 have all four of the courses; 8, all but the mining; 4, all but the electrical.

TABLE XIII.—Names, Addresses, Date of Foundation and Number of Engineering Courses of 52 Engineering Schools of the United States from which Complete Returns of Number of Graduates since their Foundation have been received.

	Name of College.	P. O. Address.	Founded.	Engineering courses.	Group.
1.	Rensselaer Polytechnic Institute	Troy, N. Y.	1824-35	C.	A
2.	Harvard University, Lawrence Scientific School	Cambridge, Mass.	1846	C., El.	A
3.	Yale University, Sheffield Scientific School	New Haven, Conn.	1847	C., M., El.	A
4.	Dartmouth College, Chandler School of Science	Hanover, N. H.	1851	C.	A
5.	Union College, School of Civil Engineering	Schenectady, N. Y.	1845	C.	A
6.	University of Michigan, Engineering Dep't	Ann Arbor, Mich.	1852	C., M., Mn., El.	A
7.	Polytechnic Institute of Brooklyn	Brooklyn, N. Y.	1854	C.	B
8.	Pennsylvania Military Academy	Chester, Pa.	1868	C., M.	B
9.	Columbia College, School of Mines	New York, N. Y.	1864	C., M., Mn., El.	B
10.	Washington and Lee Univ., Engineering School	Lexington, Va.	1866	C., Mn.	B
11.	Massachusetts Institute of Technology	Boston, Mass.	1865	C., M., Mn., El.	B
12	Lehigh University, Engineering Dep't	Bethlehem, Pa.	....	C., M., Mn., El.	B
13	University of Virginia, Engineering Dep't	Charlottesville, Va.	1868	C., M., Mn.	B
14.	Cornell Univ., College of Civil Engineering	Ithaca, N. Y.	1868	C.	B
15.	Tufts College, Engineering Dep't	Medford, Mass.	1868 (?)	C., M., El.	C
16.	University of Georgia, School of Engineering	Athens, Ga.	1867	C., M.	C
17.	Lafayette College, Pardee Scientific Dep't	Easton, Pa.	1863	C., Mn.	C
18.	Washington Univ., Polytechnic School	St. Louis, Mo.	1870	C., M., Mn.	C
19.	University of Vermont, Engineering Dep't	Burlington, Vt.	1896	C.	C
20.	Kansas State Agric. College, Mech. Dep't	Manhattan, Kan.	1862	M.	C
21	Worcester Polytechnic Institute	Worcester, Mass.	1868	C., M., El.	C
22.	Alabama Polytechnic Institute	Auburn, Ala.	1872	C., M., Mn., El.	C
23.	Maine State Coll. of Agr. and Mech. Arts	Orono, Me.	1869	C., M.	C
24.	Iowa State College of Agr. and Mech. Arts	Ames, Ia.	1868 (?)	C., M., El.	C
25.	University of Penna., Towne Scientific School	Philadelphia, Pa.	1872	C., M., Mn.	D
26.	Stevens Institute of Technology	Hoboken, N. J.	1870	M.	D
27.	University of Wisconsin, College of Mech. and Eng.	Madison, Wis.	1872 (?)	C., M., Mn., El.	D
28.	Dartmouth College, Thayer (grad.) Sch. of C. E.	Hanover, N. H.	1867	C.	D
29.	Swarthmore College, Engineering Dep't	Swathmore, Pa.	1869	C.	D
30.	Cornell University, Sibley (M. E.) College	Ithaca, N. Y.	1870	M., El.	D
31.	University of Missouri, School of Mines	Rolla, Mo.	1871	C., Mn.	D
32.	University of California, Engineering Dep't	Berkeley, Cal.	1868	C., M., Mn.	D
33.	" Kansas, Engineering Dep't	Lawrence, Kan.	1870 (?)	C., El.	D
34.	" Minn., College of Mech. and Arts.	Minneapolis, Minn.	1869	C., M., El.	D
35.	Rutgers College, Scientific School	New Brunswick, N. J.	1864	C., El.	D
36.	State Univ. of Iowa, Dep't of Eng'g	Iowa City, Ia.	1873	C., El.	D
37.	Cornell College (Iowa), Dep't of Civil Eng'g	Mt. Vernon, Ia.	1873	C.	D
38.	University of Illinois, College of Civil Eng'g	Urbana, Ill.	1867	C., M., Mn., El.	D
39.	" Cincinnati, Eng. Course	Cincinnati, O.	1874 (?)	C., El.	D
40.	College of New Jersey, J. C. Green School of Science	Princeton, N. J.	1873	C., El.	D
41.	Stage Agr. and Mech. College of Texas	College Station, Tex.	1871	C., M.	E
42.	University of Nebraska Engineering Dep't	Lincoln, Neb.	1880 (?)	C., M., El.	E
43.	Colorado State School of Mines	Golden, Colo.	1874	M., Mn.	E
44.	Western University of Penna., Engineering Dep't	Allegheny, Pa.	1879 (?)	C., M.	E
45.	Pennsylvania State College, Engineering Dep't	State College, Pa.	1874	C., M., El.	E
46.	Purdue Univ., Schools of Engineering	Lafayette, Ind.	1874	C., M., Mn., El.	E
47.	Rose Polytechnic Institute	Terre Haute, Ind.	1874	C., M., El.	E
48	University of Texas, Engineering Dep't	Austin, Tex.	1884	C.	E
49.	Michigan Mining School	Houghton, Mich.	1885	Mn.	E
50.	State Agricultural College of Mich., Mech. Dep't	Agric. College, Mich.	1885	M.	E
51.	Georgia School of Technology	Atlanta, Ga.	1888	C., M.	E
52.	Montana School of Mines of College of Mont.	Deer Lodge, Mont.	1888	Mn.	E

PROMPT CORRECTION OF ANY ERRORS IN THIS TABLE IS REQUESTED.

NOTE.—This list includes only colleges from which complete returns of graduates have been received. There are at least as many more giving more or less thorough and complete instruction in engineering, and aiming toward a first-class standing as engineering schools. Only four or five small colleges not included in the above list, however, have as yet reached that point. A number of newly founded colleges and universities bid fair to take an important place as engineering schools within a few years.

In the last column above, headed "Engineering Courses," the letter "C" signifies a course in civil engineering; "M," a course in mechanical engineering; "Mn," a course in mining engineering, and "El," a separate course in electrical engineering. Many, if not most, of the civil engineering colleges give special instruction in mining engineering if desired, but they are not classed as having such a course unless they give a degree as "Engineer of Mines" or its equivalent. Similarly, practically all of the colleges which have courses in mechanical engineering give special instruction in electrical engineering, if desired (as notably the Stevens Institute of Technology), but they are not classed as having an electrical course unless they formally differentiate it from the others.

Courses merely announced in catalogues, but which as yet appear to have had no graduates, are not considered in the above table; neither are courses which once existed, but which have been abandoned, as, for instance, the mechanical engineering course which existed for a few years only at the Rensselaer Polytechnic Institute.

A NEW EXTENSOMETER.

By J. B. Johnson.*

The extensometer shown in the accompanying engraving was designed by the writer, and is manufactured by Maher & Co., of St. Louis, instrument makers. It consists of two brass collars, having 2½ in. openings, which are held upon the specimen with three pointed steel screws. To each collar is attached a graduated circle 4 ins. in diameter, carrying upon its face a balanced vernier needle. The needle is rigidly attached to an axle which turns very freely, but without any lost motion, on which also is a perfectly true cylinder which is exactly ½ in. in circumference. A steel armature is rigidly attached to each collar, and has a friction bearing with spring pressure upon the rolling cylinder on the other collar. These cylinders and armatures, or side bars, are symmetrically mounted on two opposite sides of the bar to be tested, so that any warping or bending of the bar under test affects the movement of the two cylinders equally but in opposite directions, and the mean of the two readings is always free from the effects of such movements. The graduated circles are divided into 500 subdivisions, and the vernier on the end of the index needle reads to 1-10 of one of these spaces, so that the smallest reading of the vernier corresponds to $\frac{1}{5000}$ in.

The friction contact of the side bar upon the roller is superior to a gear in that there cannot possibly be any lost motion. When properly constructed a friction gear is the most absolutely certain and exact which it is possible to obtain. It is disturbed by sudden jars or slips in the grips, but these seldom occur. The verniers are easily read to half-ten thousandths, as will be seen in the record given below.

A test of a bar of Tennessee bloom wrought iron was made by Mr. F. E. Turneaure, Instructor in

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Civil Engineering, and two students. The record of the test is appended to show the use of the instrument in practice. It is believed that any careful observer could obtain as accurate results.

The advantages of the apparatus may be summarized as follows:

1. It is equally well adapted to horizontal and vertical positions of the test bar.

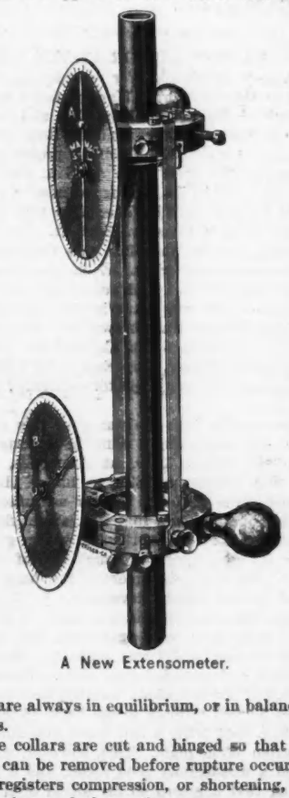
2. It gives the average stretch of both sides of the bar and so eliminates all unsymmetrical distortions of the bar.

3. The stretch is made visible to the eye of the observer so that he can see the movement and can tell when a condition of equilibrium has been reached. This is a very important feature, especially for students.

4. It is adapted to all lengths of specimen above 3 ins. by simply changing the side bars.

5. It gives stretch beyond the elastic limit as well as inside that limit by continual revolution of the index hand.

6. Both the apparatus as a whole and also the



A New Extensometer.

pointer are always in equilibrium, or in balance in all positions.

7. The collars are cut and hinged so that the apparatus can be removed before rupture occurs.

8. It registers compression, or shortening, as well as extension, and shows the permanent set at once when the load is removed.

It is well known that stretch within the elastic limit, from which the modulus of elasticity is computed, must be measured on both sides of the bar. The extraordinary range in the recorded values of this modulus is thought to be due solely to the measurements having been taken on one side only. The cost of the instrument, carefully made and guaranteed, is $100.

By an inspection of the accompanying test record it will be seen that if measurements had been taken on one side only, a very erroneous value of the modulus of elasticity would have been obtained. On the first loading to 15,000 lbs., where readings were taken for each 1,000 lbs. increment, the increments of stretch varied from .0002 to .0003 in., the average being .000245 in.

On the second loading (We reproduce in the table only the record of the first loading.—Ed.) the stretch increments per thousand lbs. varied between .000225 and .000275, the average being .000248. On the third loading the load increments were 3,000 lbs., and the stretch increments per 1,000 lbs. varied from .000238 in. to .000260 in. The first mean reading at 1,000 lbs. load was .000725 in. The second, after a loading of 15,000 lbs., was 0.00717 in. The third, when corrected for observed disturbance by jarring after a loading of 20,000 lbs., was 0.00722 in., thus showing that the readings return to their original record within 0.001 in., or within the limits of exactness of the vernier readings.

It is interesting to note also that after the bar had been loaded to 30,000 lbs., or to 38,200 lbs. per sq. in., and had elongated 4%, and the load had been let off, when it was again loaded the stretch increments regularly increased, showing that the strain diagram has become a curve from the beginning of the loading, and, strictly speaking, the bar was no longer perfectly elastic, but took a certain set for all loads. This would clearly indicate that pulling the bar beyond its elastic limit permanently injured it.

Extensometer Records in Tension Test on a Wrought Iron Bar.

(Length between collars, 6 ins.; diameter, 1 in.)

Total loads. (1 = 1,000.)	Reading of: Ver. A.	Ver. B.	Movement of: (Ten-thousandths of an inch.) Ver. A.	Ver. B.	Ave. Movement.	Total stretch.
1	87	58	...	...	2.5	2.50
2	88	61.5	1	3.5	2.2	4.25
3	88	65	2	3.5	2.7	7.00
4	91.5	68	1.5	3	2.2	9.25
5	93.5	71.5	2	3.5	2.7	12.00
6	95	74.5	1.5	3	2.2	14.25
7	97	77.5	2	3	2.5	16.75
8	99	81.5	2	4	3	19.75
9	100	84.5	1	3	2	21.75
10	102.5	87	2.5	2.5	2.5	24.25
11	104.5	90	2	3	2.5	26.75
12	107	92	2.5	2	2.2	29.00
13	110	94.5	3	2.5	2.7	31.25
14	113.5	96	3.5	1.5	2.5	33.75
15	116.5	99	3	3	3	36.75

DREDGING ON THE PACIFIC COAST.

A monograph of more than ordinary interest has just been issued by Mr. J. H. Miller, of the San Francisco bar, bearing the above title, and apparently intended primarily for use in pending patent suits of Mr. A. B. Bowers, for whom Mr. Miller is attorney. Mr. Miller's own statement of the case is given in a notice of the pamphlet in another column. It follows of necessity that the pamphlet is put out with more or less ex parte motives, and not merely in the interest of truth, so that all its statements are to be received with some grains of allowance as possibly more or less colored. This coloring, if it exists at all, is much more likely to come from the failure to record facts making the wrong way than from misstatements as to the facts recorded, but in either or both ways an unfair color may be given to the simplest records, intentionally or unintentionally, and this fact is to be borne in mind.

Nevertheless, it has often happened that patent litigations result in bringing together the most valuable records which should not be permitted to escape technical notice. In any case of magnitude on a technical question expenses are incurred to collect and classify technical facts for ex parte use which purely scientific interest would never warrant, while the other side is so sharply watched that there is little benefit in putting forward in printed form alleged statements of fact which can be shown to err materially, either in omission or commission. We judge this record of dredging work and progress on the Pacific coast to be one of this nature, and hence devote considerable space to an abstract of the facts recorded in it, holding our columns open to any corrections of the statements herein which any parties in interest may judge to be demanded.

As Mr. Miller justly states, the Pacific coast leads the world in dredging plant, remarkable as it may appear. It has originated and developed the most perfect forms of dredging apparatus. The art received its first impetus on that coast from the reclamation of swamp lands and the building of levees, the vast extent of marsh, tide and swamp lands furnishing an unusual field for the development of suitable appliances for dredging and reclamation. Later it was applied to straightening and widening deep-water channels, cutting inland canals, and deepening the waters of bays and harbors. It is in this latter work that the most perfect types of dredges have been produced. When De Lesseps began work at Panama he went to California for dredges, and Mr. Slavin and the Golden State and Miners' Iron Works furnished him with the machines, though the hulls were built in the East, after Californian plans and designs. The Panama Canal dredges were mere duplicates of what had been used in California waters, and though the canal project itself was a failure, the dredges were a success, and Mr. Slavin and his associates made fortunes out of the dredging work.

Mr. Miller classifies dredging machines under two heads, "scoop" and "hydraulic." Scoop dredges include, 1, the simple scoop; 2, the clamshell, and, 3, the chain-bucket. A fair type of the first is found in the well known Osgood scoop. This is, perhaps, the earliest form of dredge, and has been used for many years throughout the world. Its essential feature consists of a large iron scoop, shaped somewhat after the fashion of a coal scuttle, having a sharp cutting edge and a hinged bottom, arranged to open and close at will. The scoop is arranged at the end of a long derrick, which has both a horizontal and vertical motion. The appearance of this dredge and its mode of operating are so familiar to engineers that we need not describe either more in detail.

The next advanced step after the Osgood scoop was the "clamshell" dredge. This is also too well known a type to need much description. It consists of a kind of double scoop, viz., a pair of semi-cylindrically shaped converging jaws, pivoted together and opening outwardly from each other, operating on the principle of oyster tongs. In operation the excavator is lowered into the water and to the bottom with the jaws open. It there scoops up the mud by the closing of the jaws. It is then elevated to the surface and the contents are discharged into a mud-scow. Mr. Miller adds:

The earliest dredges used on the Pacific coast were the Osgood scoop and endless chain-bucket. They were small affairs, capable of handling from 500 to 700 cu. yds. per day of 10 hours. These were followed some years later by a clamshell (afterward purchased by the State Harbor Commissioners), capable of handling about 1,000 cu. yds. in 10 hours; and a subsequent clamshell, built by said commissioners and now working in San Francisco harbor, is said to have handled, in soft mud under favorable circumstances, as high as 2,000 cu. yds. in 10 hours. Some scoop dredges belonging to the Pacific Coast Dredging & Reclamation Co., and others belonging to the Southern Pacific Ry. Co., have also handled as much or more, in the same time, though the average output of clamshell dredges in San Francisco harbor for ten years was 28,845 cu. yds. per month, in soft material, and the average for scoop dredges is probably less than 1,000 cu. yds. in 10 hours, having fallen as low as 200 yds. in 10 hours in the hard bottom of Oakland Creek. All these dredges deliver their spoil into dump-scows alongside, which, when loaded, are towed to the dumping-ground, where the spoil is dumped into the water. These machines, as originally built, were designed solely for the improvement of navigation, and were not well calculated for the building of levees. This results from the fact that the range of the scoop dredge for levee purposes is very limited, as it can deposit its spoil to the distance of only a few feet from the side of the dredge However, clamshells of an improved pattern have been largely used for levees, and probably the most successful dredge for the building of levees is the common clamshell with a boom from 90 to 100 ft. long. The first successful machine of this kind was the one built soon after the expiration of the clamshell patents, by Coulton, Vcorman & Schultz, for the reclamation of Bouldin Island.

A Mr. Gwinn had, previous to this, purchased the patent for the Taggart clamshell-bucket, and attempted to use that with a long boom for levees; but he was hampered by the old clamshell patents, and for handling his bucket and boom was obliged to use older and more complicated machinery. This defect was afterwards remedied by a Mr. Piess, of Stockton, who also otherwise improved the dredge, making it nearly, if not quite, as efficient as the ordinary clamshell, though more expensive to keep in repair. This machine has done a large amount of leveeing on the swamp lands along the mouth of the Sonoma Creek for Hon. John P. Jones and his associates. The old clamshell patents have expired, and there is now nothing to prevent swamp-land owners from using that simpler and better form. There are five or six of these machines now employed in the San Joaquin and Sacramento rivers. They are identical with the old clamshell except that they have a longer boom, and some of them dispense with the guide-poles for keeping the buckets upright, and use the Taggart clamshell-bucket, a patent on which has also expired.

The chain-bucket dredge is also a scoop, or rather a series of scoops, consisting of an endless chain running over two drums, and having scoops or excavating buckets attached to the chain at regular intervals. This type also is so familiar as to need no illustration. It is a very old type of dredge, patents therefor having been granted as early as 1838 in this country, and much earlier in Europe. In 1874 one was designed and built by John Ball, of Oakland, differing somewhat from the usual con-

struction; but it was not a success, and he apparently abandoned the enterprise. The most improved form of this class of dredges is what is commonly called the Hercules dredge, more familiarly known in the East as the Slavin dredge, as used on the Panama Canal and now on the Nicaragua Canal, and frequently illustrated in these columns. Mr. Miller thus describes these dredges:

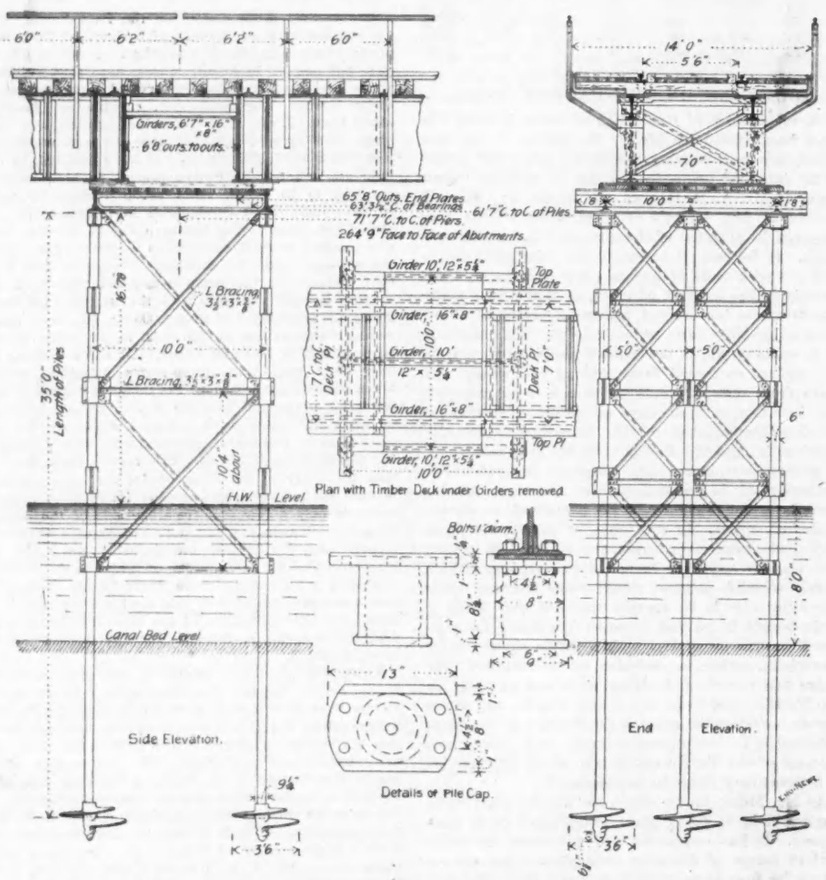
This name, Hercules dredge, was given to the first one built, but by subsequent use has become a generic term. The endless chain carries the filled buckets to a considerable elevation, where the contents are dumped into a hopper or mud receiver, which has a long iron discharge-pipe (boom) suspended from a mast and extending to the bank of the river being dredged. A force pump throws a strong stream of water into the bottom of the mud receiver, which serves to dilute the spoil and force it through the long suspended discharge pipe onto the land. The dredge works from side to side, making an arc-shaped cut while swinging on a spud as an anchor, and feeds forward by means of a secondary spud. Two of these dredges have been built by the Golden State and Miners' Iron Works, San Francisco, for Messrs. Williams & Bixler, for leveeing on the San Joaquin and Sacramento rivers. These two machines have done a vast amount of work in California, and are said to have been a source of great profit to their owners. Similar dredges were used for doing the excavating on the Panama Canal, under the superintendence of Mr. H. B. Slavin. He subsequently sold his machines to the Nicaragua Canal Co., and two of them, the "City of Paris" and the "M. A. Slavin," are now at work on the canal near Greytown.

Some endless chain dredges, with a supplemental carrier or draper, have been built and used by the Glasgow Land Co. in their reclamation work on the San Joaquin, near Stockton; but they are of small size and limited capacity, though from long use they have handled a large amount of material and built many miles of levees. Another endless chain dredge, with a ladder swinging laterally independently of the hull, was built some years ago by the United States Government, but, like similar machines previously built elsewhere, was only a partial success. The dredges used on the Suez Canal were of the endless chain-bucket pattern, but differed from the Hercules dredges in having a discharge chute resting on a lighter alongside in some instances, and in others on a track along the shore, instead of having it suspended from a mast on the vessel itself. Over sixty of such machines were used in digging that canal.

(To be continued.)

SCREW PILES FOR BRIDGE PIERS.

In an article in the "Indian Engineer" Mr. F. J. E. Spring describes a canal bridge built by him, consisting of four spans of 60 ft. with piers of 6 ins. solid shafting having screw bases 3 ft. 6 ins. diameter. Including the screw pile abutment, the bridge is 325 ft. long. The spans are built of the standard 60-ft. plate girders, 5 ft. deep, used for broad gage railway bridges, and are connected over the piers by shallow girders 6 ft. 8 ins. long. It is a deck structure with girders 7 ft. apart, carrying a single track of the Indian standard gage of 5 ft. 6 ins., while the width between handrails is 14 ft. The 60 ft. girders rest on a cap on top of a group of six piles, which form a 10-ft. square, so that the up and down stream ends of a pier have the bracing in 10-ft. panels, while the sides have the bracing in 5-ft. panels. In the canal there are short fender piles, up and down stream, braced vertically and horizontally to the square group, so as to fend off passing boats. The piles are 35 ft. long over all, and are screwed over 10 ft. into the bed of the canal.



SCREW PILE BRIDGE PIERS IN INDIA.

To carry the load through the girder bed-plates, as well as to get as long a span as possible out of the 60-ft. girders, the design was so arranged that between the ends of the two spans resting on one pier there is a space of 6 ft. 8 ins. spanned by an intermediate girder resting upon brackets fixed on the ends of the main girders. One end of each small girder is riveted to the sliding end of a main girder; the other end of the small girder slides in a suitable fixture on its bracket, which is attached to the fixed end of the next main girder; the space for sliding being sufficient for the expansion of 70 ft. of iron.

The main girders rest upon a square cap 8 ins. thick, of teak scantlings, formed of two 4-in. layers, crossing in the grain, strongly spiked together and thoroughly tarred. Between the girder bed-plates and this teak floor are two ¾-in. plates, one for each pair of girders, each 10 ft. by 2 ft. 6 ins. The rest of the teak is covered with sheet iron as a protection from fire. The teak cap rests on a heavy iron framework of girders resting on the top of the piles, and riveted to each other as well as to the caps of the piles.

The bracing is connected to the piles by clips made of ¾-in. plates. These clips are quite easily made of plate, but better of 8×¾-in. bar. The bar is best shaped for the clips by bending it hot round a pile shaft. When all is braced and riveted together, the group forms an extremely stiff structure, as was proved by the difficulty of getting it to give, even with the aid of a powerful tackle, to fit an obstinate bar.

The cost of the work complete was $16,750, or about $51.50 per foot.

THE LATEST ARMOR PLATE TESTS.

The highest resistance ever recorded in an armor plate test was shown by a Harvey nickel steel plate made by the Bethlehem Iron Co., and tested on July 30 at the proving grounds at Redington, near Bethlehem. Five 250-lb. Holtzer projectiles were fired against the plate from an 8-in. gun, with a powder charge of 81 lbs., giving the missile a velocity of 1,700 ft. per second. The plate was 10½ ins. thick and its face measured 8×6 ft. The position of the five shots on the plate was the same as in former armor plate trials. Each shot penetrated the plate about 3 ins. and rebounded, broken up. Not a single crack was made in the plate and very little of the surface was thrown off. The test was made by the Bethlehem Iron Co. and was witnessed by Commodore Folger, Superintendent John Fritz and the army and navy inspectors stationed at Bethlehem.

The remarkably high resistance of this test may be realized by comparing it with the important tests made in September, 1890, at Annapolis, and in October and November, 1891, at Indian Head. In the former three plates of foreign manufacture received each one 8-in. and four 6-in. shots; the nickel steel plate made by Creusot & Co. won a great victory over its competitors, although two of the 6-in. shots and the 8-in. shot pierced the back of the plate and several cracks developed. In the Indian Head test, fully reported in our issue of Nov. 28, 1891, the shots fired were again four 6-in. and one 8-in., and the best record was made by a Bethlehem Harvey high carbon nickel steel plate. The average penetration of the five shots was 9½ ins., two 6-in. projectiles pierced through to the back of the plate, and the 8-in. shot made a bad crack extending from top to bottom of the plate. This, however, was then considered a wonderfully good result, and it is most astonishing that a record so far ahead of it should be made in so short a time.

A twin plate to the one tested at Redington was tested at the Indian Head proving grounds on July 23. Five 8-in. projectiles were fired against it, three of which broke up with only about 3 ins. penetration, as was the case at Redington. The points of the two others penetrated to the rear of the plate and one corner of the plate was cracked. Thus the plate came out with much less injury than did the best plate in the 1891 tests, although its resistance was not quite equal to that of the plate tested at Redington, above reported. Its record is a most important one, however, as when taken in connection with that made by its twin at Redington it proves quite conclusively that an enormous advance has been made in the application of the Harvey process to armor plate manufacture. We have commented on these results elsewhere.

THE DISASTER AT THE LICKING RIVER BRIDGE.

In our issue of June 23 we published as complete an account as it was then possible to obtain of the false works failure at the Licking River Bridge in Covington, Ky., by which 25 lives were lost. At that time most of the evidence at hand pointed to defective piling and bracing as the original cause of the accident, but we then expressed our belief that

this was not the main cause. The coroner's report on the accident, the important parts of which we give below, ascribes it to the fall of the traveler, due to the spreading of the rails, and holds the contracting firm of Baird Bros. blameless for the accident.

Some 30 witnesses were examined in the coroner's investigation. The following is the substance of the verdict:

That the Baird Bros. are in no manner to blame for the accident that befell them, which was purely accidental, and human forethought and prudence could not have prevented said accident.

That said accident was not caused by insufficient pile driving, defective timber, blocking, tackle, etc., or by defective false work, but was caused by the rails spreading suddenly near the pier on the Newport side, underneath the traveler, throwing the leg on the northeast corner of said traveler from the track, and precipitating said traveler from the track, which at this time was supporting the north chord, weighing five tons, into the river, thereby dragging all other parts of the structure from the Newport toward the Covington side of the river.

That the testimony shows that Baird Bros. are known as competent and prudent bridge builders, and employ only competent and prudent foremen to govern their work, and have built many large bridges with less loss, all over the country, than almost any other firm.

That the span between the piers is 350 ft., with a double bent over the channel of the river, and the remainder were single bents, built upon the piles, and which forms the false work, which in turn supports the traveler and iron work until connected. These piles were composed of pine and cypress principally, with some oak, were in good condition, and ran from 35 to 38 ft. according to the depth of water in the river, and were braced on the double bent. The false work was well-braced, and good timber used and well bolted together, and although some timber had been used previously, only that which was sound was used, and this it is customary to do in bridge building. The false work was held together at the top with bracing and stringers 8 × 16 ins., which in turn supported ties 4 × 10 ins., on which ran the rails that supported the traveler, and all were well bolted together with iron.

The testimony also shows that blocking the tracks of the traveler in bridge building is very frequent, and not necessarily due to the piling sinking, but to level any part that may not fit exactly at the time until it can be better fastened together and kept plumb. The piling was driven with an extraordinarily heavy hammer, weighing 4,200 lbs., and was dropped differently at different places, ranging from 3 ft. at starting of pile to 20 ft. after being partially driven, and were driven 12 to 15 ft. into the bed of the river. That upon examination these piles in many places were broken off 4 ft. in the ground, and in other instances at the surface of the ground. That upon a test to remove one of the piles with a 25 HP. engine, with double fall blocking, which increased the power of said engine to 100 HP., the piles failed to be moved with the engine carrying 75 lbs. of steam, and that upon trying to drive the piling further into the bed of the river with above mentioned hammer, dropping it several times on the piling at a height of 20 ft., it failed to sink ⅛ in. lower. That piling after being driven into soft mud or sand will tighten after standing, even in a very few hours. That iron bands were used on the ends of the piling when driven, and when the band puller removes them there is a lever which prevents the engine from loosening the piles.

That the blocking, tackle, chains, etc., were in good condition, and that the river at time of pile driving was about 30 ft. deep, and very little current, and not at all unfavorable to the work.

That the traveler was built of good materials and the rails well put down, and that the accident was unavoidable, and prudence would not have prevented it.

LOSS OF HEAD RESULTING FROM THE PASSAGE OF WATER THROUGH A 24-IN. STOP VALVE.

On May 31, 1891, Messrs. E. Kuichling and John Thomson, M's. Am. Soc. C. E., made some experiments to determine the loss of head in the passage of water through a 24-in. stop valve, opened to different heights. The results of the experiments were presented on March 2, before the American Society of Civil Engineers, in a paper prepared by Mr. Kuichling, and from that paper the following abstract has been prepared:

The valve in question was made in 1874 by the Ludlow Valve Manufacturing Co., of Troy, N. Y. It has two parallel and circular cast iron disks, with faces about 6 ins. apart and 26.5 ins. in diameter. The brass rings forming the valve seats are each 24.0625 ins., internal diameter. The screw stem which moves the disks has about three threads per inch and overlaps the valve seat at the bottom by about one inch, so that about three turns of the stem is required to bring the valves to a full bearing after the passage has been closed.

The valve was placed on a continuous gravity line of 24-in. cast iron pipe leading from a storage to a distributing reservoir. The valve was located 46,219 ft. from the storage, and 648 ft. from the distributing reservoir, or rather there were these lengths of pipe between the valve and each reservoir. The difference in level between the two reservoirs at the time of the experiments was 112.89 ft.

With the valve wide open the pipe would have a total length of 46,867 ft.; a total head of 112.89 ft.; and a nominal diameter of 2 ft. The instrument employed to determine the loss of head is termed a pressure difference gage, and consisted of two communicating columns of mercury, thus described by Mr. Kuichling:

"In principle, the gage consists of two vertical glass tubes, connected together at the bottom and partially filled with mercury, while the upper ends of these tubes are connected with the water main by means of suitable cocks and piping. On the admission of the water into the two tubes, the mercury will be depressed in one and raised in the other until equilibrium is established, whereupon the difference in the heights of the two mercury columns is to be read off on a suitable scale, whose divisions correspond to known pressures of water, as determined by careful experiment beforehand. In practice, however, it is necessary to exercise the utmost care to expel all of the air in the tubes above the mercury, except when compressed air alone is applied in both, and for this purpose a little complication of the apparatus seems unavoidable."

Experiments in connection with the above gage led to the assumption that a head of 1.0493 ft. of water would balance a head of 1 in. of mercury in the gage. This factor was used in computing the results of the experiments.

The total loss of head in the pipe, due to the valve disks alone, when opened as stated, was as follows:

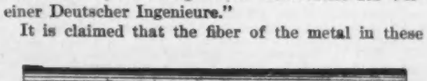
Valve opened, inches.	Ratio of opening to diameter of pipe (24 ins.).	Loss of head in feet.
4½	1/5	9.281
4⅝	5/26	8.100
5	1/4	7.203
6	1/4	5.304
8	1/3	2.814
9	3/8	2.078
10	5/12	1.532
11	11/24	1.112
12	1/2	0.797
14	7/12	0.378
16	2/3	0.189
24	1	0.000

Mr. Kuichling gives in detail the processes by which these results were obtained, and makes some interesting comparisons between his deductions regarding coefficients for loss of head and those obtained by Weisbach. With the valve raised to or between ¼ and ¾ of its diameter, the results differ largely from those of Weisbach, the only satisfactory agreement being for the flow between the 0 and ¼ point.

NEW TYPE OF MANNESMANN BOILER TUBES.

Seamless boiler tubes with decreasing thickness of shell for locomotive and other boilers are being manufactured by the German-Austrian Mannesmann Tube Works, according to the "Zeitschrift des Vereiner Deutscher Ingenieure."

It is claimed that the fiber of the metal in these



New Type of Mannesmann Boiler Tube.

tubes, being spiral, permits a high interior pressure. Another advantage claimed is that the thickness of the shell of the tube is increased at the end coming into direct contact with the fire, as shown in the accompanying sketch, and allows for the scaling off of the material. For instance, locomotive boiler tubes of 1 25-32 in. outside diameter have at the end exposed to the fire a thickness of shell of ⅛-in., while the thickness at the smokebox end is only 3-32 in. The exterior of the tube is cylindrical and the interior is conical.

These tubes are manufactured of soft or medium steel in sizes ranging from 1 25-32 ins. to 4½ ins. outside diameter. It is stated that 60 locomotives have been fitted with this new type of boiler tubes.

The work on harbor improvement at Corpus Christi, Tex., which has been carried on for some time by Col. E. H. Ropes and his associates, has been abandoned for the present for lack of funds.

The deep sea soundings for a submarine cable between California and the Sandwich Islands, which have been made by the "Albatross" and the "Thetis," have resulted in finding a very good route in a nearly straight line between Monterey Bay and Honolulu. The bottom was found at a depth of about 2½ miles.

The Howard St. tunnel of the Baltimore Belt R. R. will have to be rebuilt for a short distance near Franklin St., on account of settlement of the foundation walls, caused by springs washing out the material beneath them. As stated in our description of this tunnel in our issues of Dec. 12 and 19, 1891, the ground through which the tunnel is driven is so saturated with water that it has been necessary to drain the ground in advance of the headings by driven wells. It is also stated that unequal loading of the tunnel arch has forced it out of shape at some points, so that it will require rebuilding.

Competitive tests of pneumatic tubes have been ordered by the Postmaster-General, and the inventors or owners of pneumatic tube patents are invited to submit their devices to the Post Office Department before Sept. 8, 1892. Competitors must give a full description of their devices, state their capacity, method of application and kind and quantity of motive power used, and state the time and place at which their plant may be tested; and they must bear all the expense attending the test. Full instructions to intending competitors may be obtained on application to the Department.

Several compound locomotives are being built by the Rhode Island Locomotive Works, of Providence, R. I. They include three double truck, four-cylinder compound engines for the Mexican Central Ry., designed by Mr. F. M. Johnstone, Superintendent of Machinery (Eng. News, March 12 and 26, April 2 and 9); also one of Mr. Johnstone's ten-wheel, four-cylinder compounds for the Mexican Northern Ry., and another for the Mexico, Cuernavaca & Pacific Ry. These two are practically duplicates of those built for the Mexican Central Ry., and illustrated in our issue of Aug. 29, 1891, except that the latter of the two new engines is designed to burn wood for fuel, in consequence of which it is necessary to make a deeper firebox. The works are also building a simple engine for the road, made from the same drawings, only not compounded. Two eight-wheel compound locomotives, for passenger service on the Minneapolis & St. Paul R. R., have recently been shipped. These are of the Rhode Island Locomotive Works design, on the two-cylinder system (Eng. News, Dec. 12, 1891), and a two-cylinder compound ten-wheel engine of the same design has been built for the Northern Adirondack R. R. The works also have an order for two compound consolidation freight locomotives for the Minneapolis, St. Paul & Sault Ste. Marie Ry. These compound engines are said to be giving satisfaction wherever they are in use.

An experimental chamber was tested by representatives of the Brown Wire-Wound Gun Co. on July 28 to a pressure of over 66,000 lbs. per sq. in. The test was made at the shops of the company, located at Birdsboro, Pa. The chamber tested was 5 ins. in diameter and 6½ ins. long, internal dimensions; and 2½ lbs., 3 lbs. and 3¼ lbs. of powder were successively fired in this closed space without causing rupture. The chamber is constructed in the same manner as the gun itself. There is first a thin lining tube, then a tube made up of longitudinal segments like the staves to a barrel, which in the chamber tested was 11 ins. in outside diameter, and then a jacket of steel wire, which is the sole reliance to resist bursting and which in the gun tested was 2.17 ins. in thickness. A 5-in. gun is now being built at Birdsboro and will be ready for use in a short time. It is expected that the projectiles from this gun will receive an initial velocity of 2,600 ft. per second, with a chamber pressure of 50,000 lbs. The service velocity of the 5-in. breech-loading rifle, U. S. Navy is 2,000 ft. per second, with a pressure in the powder chamber of 15 tons.

An incline railway for passenger service, somewhat similar to those at Pittsburg and Cincinnati, has been built at Bridgnorth, England, to connect the upper and lower parts of the town. The grade is 1 in 1½, and the maximum depth of cut 50 ft. The length of track is 20 ft. and the vertical lift 111 ft. There are two tracks laid with steel rails, bolted to cross ties, bedded in concrete, and drift bolted to the rock. There are two cars, each running on four wheels, and they are connected

by two steel ropes passing round a sheave at the top of the track. The upper part of the car is built much like a street car, and carries 18 passengers. The triangular frames under the horizontal floor of the car form a water ballast tank, the descending car having its tank filled and pulling up the ascending car. Wedge brakes are automatically applied in case of the ropes breaking and automatic brakes are also applied at a certain speed. The cars cannot run down when unattended, but both brakemen must hold the brakes off. Water is pumped to the upper tank by a gas engine. Mr. G. Croydon Marks is the engineer.

The Dismal Swamp canal, which cost in round figures $1,500,000, was sold at auction on July 26 for $10,100 to the contracting firm of Ross & Sanford. The canal is 23 miles long, extending from Norfolk south through the Great Dismal Swamp. Its construction was authorized in 1787, but over 40 years elapsed before its completion. In 1871 the late Wm. J. McAlpine advised the purchase of the canal by the city of Norfolk for water supply purposes, and it is understood that the present purchasers will improve the canal for the purpose of furnishing a water supply to Norfolk and the cities in its vicinity.

The draw span of the Macomb's dam bridge over the Harlem River, New York City, which has been closed owing to the work on the new bridge, has been floated down bodily to a new site to serve as a temporary bridge. Cribs were built on two barges which were floated one on each side of the pivot pier, and were secured together at the bow. The rise of the tide lifted the bridge about 4 ft. above the pier. The barges were then towed clear of the pier, the sterns braced apart, and the bridge was towed across and a short distance down the river where it was lowered to a temporary pier until the new pivot pier for the temporary bridge is completed, when the span will be placed upon it in the same way. We shall give further particulars of this work later.

The ocean records are being lowered with startling rapidity this summer. Following close on the phenomenal run of the "City of Paris," reported last week, comes a remarkable run from Havre to New York, completed on July 20, by the "La Touraine," of the French line, in 6 d., 17 h., 30 min., beating all records ever made over the course. During the voyage she made the greatest day's run on record, 528 miles in 24 hours. The best previous record was 520 miles, made in the last record-breaking trip of the "City of Paris."

The long distance electric transmission plant at Portland, Ore., described in our issue of July 21, has passed under the control of the General Electric Co., which proposes to greatly enlarge it. The Portland General Electric Co. has been organized with a capital stock of $1,250,000 and will be bonded to the extent of $2,500,000. The money raised by the bond issue will be expended in the development of the plant. There are few places in the country where equally good opportunities exist for the development of a great electric transmission plant and the utilization of the power in a large city. The available power of the Willamette Falls is about 250,000 HP. and it is situated only 14 miles from Portland.

CONSTRUCTION NEWS.

RAILWAYS.

East of Chicago.—Existing Roads.

OTTAWA, ARNPRIOR & PARRY SOUND.—The contract for the first section of 35 miles has been awarded to Messrs. Fauquier, of Toronto. Work was commenced July 20 and is to be completed by Oct. 20. The work is not very heavy, but there will be some bridge work. The rails will be 72-lbs. per yd. J. R. Booth, of Ottawa, is President. Geo. A. Mountain, of Ottawa, is Chief Engineer of the road, as well as of the Canada Atlantic Ry. Surveys have been completed for the entire route, 250 miles.

OTTAWA & GATINEAU VALLEY.—The road is built and in operation for 30 miles, and another 10 miles well advanced in construction. It passes through a mountainous region, but is already developing considerable passenger and freight business. W. D. Harris, of Ottawa, is Chief Engineer.

MONTREAL & OTTAWA.—At the annual meeting of the Canadian Pacific Ry. Co., at Montreal, in June, a resolution was passed authorizing the directors to lease this road in perpetuity at a rental of 5% on the bonds, which were not to exceed $17,500. The Canadian Pacific has taken possession and is now operating the line (which is on the west side of the Ottawa River) as far as Rigaud. An additional 7 miles, from Rigaud to Point Fortune, were completed in July, and will also be worked by the Canadian Pacific. The Montreal & Ottawa was originally closely allied to the Grand Trunk Ry., but the Canadian Pacific obtained control in order to prevent the Grand Trunk from getting into Ottawa, and it is not thought that the road will be built beyond Point Fortune.

HARTFORD & CONNECTICUT WESTERN.—It is stated that new surveys have been begun on the proposed extension from Tariffville, Conn., to Springfield, Mass., about 18 miles. The line was surveyed two or three years ago, and some small amount of grading done, but the company having secured another entrance into Springfield, it was abandoned and nothing has been done since. The consolidation of the road with the Philadelphia & Reading system has caused the resumption of work on the proposed extension.

WILKES BARRE & EASTERN.—The officials of this company state that about nine miles of its line from Wilkes Barre to Stroudsburg, Pa., have been graded and that contracts for the remainder of the line will be let. The local papers state that men and teams are arriving on the grounds in large numbers and every preparation is being made to push the work. Pres., W. P. Ryman, Wilkes Barre, Pa.

LOUISVILLE, NEW ALBANY & CHICAGO.—The city of Lafayette, Ind., has voted a subsidy of $130,000 to secure the general shops of this company.

NEW YORK, NEW HAVEN & HARTFORD.—The contract for the long cut and tunnel at New Haven, Conn., has been let to Brown & Ryan, of New York City. The work includes a 1,000-ft. tunnel through "brownstone" and granite and one-fourth of a mile trestle over the salt marshes. The work will be for two tracks, will cost $500,000, and will take about 16 months to complete.

BEECH CREEK.—The 15-mile extension from Kerrmoor to Mahaffey, Pa., will be completed about Sept. 1.

NEWPORT & SHERMAN'S VALLEY.—Grading has been commenced on the extension to New Germantown, Pa.

PENNSYLVANIA.—Work will be begun at once laying the second track on the Trenton Cut-off from Morrisville, N. J., to Glenlock, Pa. The road was graded in 1891 for two tracks, but only a single track was laid.—The following is an official report of the new track laid during the first six months of 1892, on the lines east of Pittsburg and Erie: New York Bay R. R., extension of branches, 1.14 miles; Kensington & Tacony R. R., extension, 0.87 mile; Cambria & Clearfield R. R., Whitehead branch, 0.7 mile; Sutler branch, 0.37 mile; Chest Creek branch, 19.71 miles; Tyrone & Clearfield Ry., Pine Run extension, 3.66 miles; Southwest Penn. Ry., extension of branches, 1.17 miles; West Penn. Ry., extension of branches, 1.16 miles; Martin's branch, extension, 0.49 mile; Tearing Run branch of Indiana branch, 0.96 mile; South Fork R. R., extension, 0.21 mile; West Jersey R. R., extension to Stone Harbor, 3.29 miles.

GRAND TRUNK.—This company is inviting bids for supplying cross ties, lumber, fence posts, etc., required by the company in 1893. Bids will be received until Aug. 31. Gen. Man., L. J. Seargeant, Montreal, P. Q.

BAIE DES CHALEURS.—It is stated that a compromise has been effected between the several parties interested in this road and that an application will be made for power to reincorporate the company under the name of the Bonaventure & Gaspe Ry. Co. The present company was chartered in 1882 to build a railway from Metapedia to Paspebiac, P. Q., about 100 miles, and the line was completed from Metapedia to Cascapedia River in 1888. Later power was given the company to extend its line to Gaspe, P. Q. The several parties interested in the road are now making an inspection of the route of the proposed extension.

NEW YORK CENTRAL & HUDSON RIVER.—This company is stated to have purchased the Adirondack & St. Lawrence R. R., now being built by W. Seward Webb, from Poland, N. Y., to Valleyfield, P. Q., and will operate it as a portion of its system.

Projects and Surveys.

ALTOONA & PHILLIPSBURG CONNECTING.—Pres. S. B. Langdon, Bullitt Building, Philadelphia, Pa., writes us that this road will be 22 miles long and will run from Steiner's, Pa., via Mapleton, Osceola, Decatur, Moshannon, Brisbin, Sterling, Houtzdale, Loraine, West Moshannon, Kendrick, Ramey, and Kitaning to Janesville, Pa.; and it is an independent line designed to connect the Pennsylvania and Beech Creek railways. The surveys have been completed and the maps and profiles made, and work is now in progress securing the right of way. The work will be light; maximum grade 42 ft. per mile. Ch. Engr., W. T. Forsyth. From the above description of the route in would appear that the line has almost exactly the same route as the Moshannon branch of the Tyrone & Clearfield Ry.

KISHAQUILLAS VALLEY.—F. F. Whittekin, Ch. Engr., Leicester, Pa., writes us that the preliminary surveys have been made for this railway from Reedsville, Pa., to Belleville, Pa., 9½ miles, and that the locating surveys will soon be made. The road is projected to develop local interests and its principal business will be agricultural produce, iron ore, coal and timber. Pres., Samuel Watts, Belleville, Pa.

FORT PLAIN & RICHFIELD SPRINGS.—Pres. Wm. Clark, Ft. Plain, N. Y., is reported as saying that a responsible New York City banking firm had been secured to take this road off the hands of the local committee and construct it. The line from Ft. Plain to Richfield Springs, N. Y., about 25 miles, was surveyed in 1887, and its projectors have been making more or less active efforts to secure its construction ever since.

ALLEGHENY & LAWRENCE.—Chartered in Pennsylvania to build a railway from Bryant to Moravia, Pa., with a capital stock of $1,500,000. Pres., Geo. T. Oliver, Pittsburg, Pa.

MANCELONA & NORTHWESTERN.—Pres. W. H. Thompson, Mancelona, Mich., writes that the surveys will be completed and grading begun on this 8-mile road from Mancelona, Mich., about Aug. 10. The line will be built by the company and will probably be completed about April 1, 1893. It is being built in the interest of the Mancelona Handle Co.

Southern.—Existing Roads.

FLORIDA CENTRAL & PENINSULAR.—The lease of the South Bound R. R., from Savannah, Ga., to Columbia, S. C., 142 miles, by this company, has been signed, and surveys are now in progress for the connecting line from Savannah, Ga., to Jacksonville, Fla. It is thought probable that construction will begin this summer. The line will pass through Brunswick, Darien and St. Mary's, Ga., and will open up a comparatively new territory.

OHIO VALLEY.—Tracklaying has been completed on the line from Princeton to Hopkinsville, Ky., 10 miles.

JACKSONVILLE, ST. AUGUSTINE & HALIFAX RIVER.—The location of the extension from New Smyrna to Titusville, Fla., has been completed. Construction is now in progress from Daytona to New Smyrna, about 16 miles.

RICHMOND, NICHOLASVILLE, IRVINE & BEATTYVILLE.—The stockholders of this company met at Louisville, Ky., July 30, to consider the plans for completing the line from Irvine to Beattyville, Ky., as originally projected. It was decided to float new bonds on the line already built, and a committee was selected to secure the consent of the opposing bondholders.

CHARLESTON, CINCINNATI & CHICAGO.—Some of the officials of this company have made a preliminary examination of the country between Lancaster, S. C., and Charlotte, N. C., with the view of building a branch to the last named town. The line would be about 40 miles long and is estimated to cost completed and equipped $14,000 per mile.—The Tennessee courts have confirmed the sale of the several roads that were built in that state as links of this railway. This is stated to have removed all legal obstacles to the consruction of the line, and it is now announced that all arrangements are made for completing the road.

BALTIMORE & OHIO SOUTHWESTERN.—The Baltimore & Ohio Southwestern Terminal Co., of which Gen. Orland Smith, Vice-President of the B. & O. is President, is preparing to build extensive terminals in Cincinnati, O., for the use of the Baltimore & Ohio Southwestern R. R. The company was organized with a capital stock of $500,000 and has been gradually acquiring property in and around Cincinnati, and having secured about all that is necessary to carry out its plans it will at once proceed with the contemplated improvements. These will include freight depots, freight-yards, round-houses and car shops. The Terminal company will lease property to the railroad company. An extensive tract of land has been secured just outside of Cincinnati, which will be converted into a freight-yard and upon which repair shops will be built. The company has also bought a desirable tract almost in the heart of the city, which is now being filled up and graded, and upon which commodious freight depots will be erected. The company is going ahead as rapidly as possible with its work, which when completed, it is said, will give the system as convenient and satisfactory terminal facilities as are possessed by any road in the Southwest. In addition to the improvements of Cincinnati, the Terminal company will also build car shops and round-houses in Chillicothe, O., for the use of the railroad company. These will cost about $250,000. The town subscribes $85,000 of this sum as an inducement for the location of the shops within its limits.

NASHVILLE, CHATTANOOGA & ST. LOUIS.—The contractors for the branch from Huntsville, Ala., south to Hobbs Island, 14 miles, are A. N. Nichols & Co., of Huntsville, Ala.

LOUISVILLE, ST. LOUIS & TEXAS.—At a special meeting of the directors recently held the construction of an extension from West Point to Louisville, Ky., was considered at some length. The company now uses 28 miles of the Newport News & Mississippi Valley R. R. tracks between these points.—A meeting of the directors of the Louisville, Hardinsburg & Western R. R., was recently held to consider the construction of a branch from Fordsville to Hartford, Ky., about 15 miles.

PIEDMONT, LANEY & BIRMINGHAM.—This company expects to begin work next month on its line to Piedmont, Ala., 12 miles. Pres., J. C. Laney, Laney, Ala.

ARCADIA, GULF COAST & LAKELAND.—Treas. F. C. Peters, Arcadia, Fla., informs the "Manufacturers' Record" that this road is now in operation from Sarasota to Braidentown, Fla., 13 miles, and that the company is busily engaged on the balance from Lakeland to Boca Grande, Fla.

SCOTTSBORO & GUNTERSVILLE.—The contract for building this railway from Scottsboro to Guntersville, Ala., about 30 miles, has been let to J. C. Neville, of New York City, and it is stated that work is now in progress. Atty., Thos. Fitch; Supt. Cons., J. T. Morgan; both of Scottsboro, Ala.

CHATTANOOGA SOUTHERN.—The engineers of this company will, it is stated, soon begin surveys from Gadsden to Montgomery, Ala. E. F. Willman, Chattanooga, Tenn., Engr. in Chg.

GURLEY & PAINT ROCK VALLEY.—The grading has been completed on the first 5-mile section from Gurley, Ala., up Paint Rock Valley, and work on the second 5-mile section will soon begin.

Projects and Surveys.

CAPE FEAR & NORTHERN.—This company, which was chartered at the last session of the North Carolina Legislature, to build a railway from Durham to Lillington, N. C., is taking steps toward getting its project under way. E. B. Barbee, of Raleigh, N. C., is interested.

Northwest.—Existing Roads.

CHICAGO & NORTHWESTERN.—An official informs us that the only new work being done by this company is the straightening of the old line on the Iowa Division between Jefferson and Coon Siding, a distance of 5 miles, and the building second track between Lake Bluff and Spring Bluff, 11 miles; between Des Plaines and Burlington, 16 miles, and between Racine and So. Milwaukee, 14 miles. There is a 3-span double track lattice deck bridge, 420 ft. in length over Coon River on the line between Jefferson and Coon Siding.

MILWAUKEE & NORTHERN.—Surveys have been commenced for a branch from Wasaukee to timber lands, and it is stated that the line will be built before next spring.

NORTHERN PACIFIC.—The Sanborn, No. Dak., "Enterprise" states that orders have been issued for the extension of the Sanborn, Cooperstown & Turtle Mt. branch from Cooperstown, No. Dak., to Odessa, No. Dak., about 40 miles. The extension is to be completed this year.

Projects and Surveys.

ILLINOIS WESTERN.—Chartered in Illinois to build a railway from the Chicago, Burlington & Quincy R. R., near Canton, southeast to the Illinois River, and also to build and acquire lines from towns in Fulton Co., Ill., to connect with the first named line.

ILLINOIS.—This company has been chartered to construct a railway line from Chicago to Rock Island, with a branch from Chicago to a point on the eastern boundary of Illinois at or near the south boundary of Cook Co. The capital stock of the company is $4,000,000, and it will have its headquarters in Chicago. The incorporators are James M. Caldwell, George F. Watson, John C. Reynolds, Edwin L. Waugh and William Dallin, all of Chicago.

Southwest.—Existing Roads.

SOUTHERN PACIFIC.—C. Kiel, of San Antonio, Tex., has the contract for grading the 15-mile branch from Iberia to Abbeville, Tex., and contracts are to be let for the ballasting and tracklaying. Constr. Engr., E. B. Cushing, Houston, Tex.

ST. LOUIS & HANNIBAL.—The extension from New London to Perry, Mo., about 18 miles, has been opened for traffic.

LOUISIANA NICKEL PLATE.—Tracklaying has been completed from Allendale, La., north to Hicks, 3 miles, and grading and tracklaying are in progress between Hicks and Bellevue, La., 9 miles.

TEXAS & PACIFIC.—It is reported that this company proposes to complete the partly graded Denison, Bonham & New Orleans R. R., from Denison to Bonham, Tex., and to operate it as a portion of its line.

KANSAS CITY, NEVADA & FT. SMITH.—The contractor for the extension of this road, noted last week, is L. J. Smith, Kansas City, Mo.

ST. LOUIS, CAPE GIRARDEAU & FT. SMITH.—The County Court of Butler Co., Mo., has granted this company 10,000 acres of county land for right of way for the proposed extension to Poplar Bluff, Mo., from Wapapello, Mo.

ST. LOUIS & SAN FRANCISCO.—It is again reported that this company will soon begin surveys for an extension of its line from Sapulpa, Ind. Ter., southwest.

Projects and Surveys.

PITTSBURG, FT. SMITH & SOUTHERN.—Chartered in Kansas to construct a railway line from Pittsburg, Kan., through Crawford and Cherokee counties and by the most practicable route to Ft. Smith, Ark. The corporation has a capital of $6,000,000. Its principal offices are to be at Pittsburg, and the directors are Jas. H. Pickering, Finis E. Marshall and Fred Wild, of Kansas City, Mo.; Chas. B. Riley, Thomas J. White and Chas. W. Trickett, of Kansas City, Kan.

KANSAS CITY, PITTSBURG & WESTERN.—Chartered in Kansas to build a railway from a point on the state line on the east side of Crawford Co., and form ng a connection with the Kansas City, Nevada & Fort Smith R. R., as the same shall be herafter located, and running thence through the counties of Crawford, Cherokee, Labette, Montgomery, Chautauqua and Cowley to the southwest corner of Cowley Co. The estimated length of this railway is 250 miles. Its principal office will be at Pittsburg, and it will also have a capital stock of $6,000,000. Its directors will be E. L. Martin, Richard Gentry, A. E. Stillwell, J. McD. Trimble, C. J. White, W. S. Taylor, all of Kansas City, Mo., and Charles Dixon, O. D. Hall and J. J. Spencer, of Kansas City, Kan.

NEW ORLEANS BELT.—The promotors of the belt railway at New Orleans, La., popularly known as the Schreiber Belt, claim to be ready to begin the construction of this proposed line at once.

GALVESTON & BEAUMONT.—There is considerable talk of a railway to be built from Galveston, northeast, to Beaumont, Tex., and it is possible that some definite steps toward the construction of such a line will be taken soon.

Rocky Mt. and Pacific.—Existing Roads.

COLUMBIA & PUGET SOUND.—The contract for the 8½-mile extension of the Maple Valley branch, noted last week, has been let to Henry & Balch.

COLORADO MIDLAND.—The location of the branch to the Cripple Creek mines in Colorado has been completed and grade stakes are now being set. It is expected that the contracts will be let and work in progress within a month.

ATCHISON, TOPEKA & SANTA FE.—A dispatch to the San Francisco "Call" from Washington, D. C., contains the following concerning the long projected extension of the Atlantic & Pacific R. R., to San Francisco: "Direct from a high Sante Fe official to-day the "Call" correspondent is enabled to state as a fact that within a few months the Santa Fe will build a line into San Francisco. The road will run in as straight a course as possible to connect with the Atlantic & Pacific R. R., near or at Mojave. President Manvel secured the money to build the road on his recent trip to Europe. The Sante Fe official intimated to the "Call" correspondent also that the Sante Fe would build a road north from San Francisco to connect with the Northern Pacific."

GREAT NORTHERN.—Tracklaying has begun on the Pacific extension, west from Spokane, Wash., and is now progressing at the rate of two miles per day. After the first 15 miles are laid it is expected that the rate can be increased to four miles per day.—Numerous reports are in circulation to the effect that this company will build a line to San Francisco, Cal., from Butte, Mont., at an early date. A dispatch to the San Francisco "Chronicle" from St. Paul, Minn., dated July 18, says: "Pres. Jas. J. Hill, of the Great Northern, will extend his line from Butte, Mont., via Boise City to San Francisco. He has entered into a construction contract with D. C. Sheppard, of St. Paul, for the building of the line, and much of the heavy work will be done during the coming winter."

Projects and Surveys.

ARCATA & MAD RIVER.—This company is making surveys for a railway from North Fork to Canon Creek, Cal., 5 miles. Pres., Andrew Corbell, San Francisco, Cal.; Ch. Engr., P. E. Herrick, Arcata, Cal.

SAN JOSE & SAN FRANCISCO TRANSPORTATION CO.—The "Railway Review" says: "The San Jose & San Francisco Transportation Co. has secured right of way for a broad gage railroad from San Jose to Alviso, a distance of about 15 miles. The road has been surveyed and operations will be commenced at the Alviso end within 30 days. The route is over level ground and no grading will be necessary, so the work of construction can be pushed rapidly to completion. The rails and ties and a portion of the rolling stock have been ordered from the east and have been shipped to San Jose. The road will be completed within 90 days. Near Alviso a wharf is to be built. W. R. A. Johnson is president of the road."

BILLINGHAM BAY & EASTERN.—Ch. Engr. J. J. Donovan, New Whatcom, Wash., writes us that this road is 3½ miles long, including sidings and trackage rights on the Lake Whatcom Electric Ry. The road commenced operations June 1, 1892, and its principal business is coal and lumber. No immediate extensions are projected.

Foreign.

TRANS-SIBERIAN.—Press dispatches from St. Petersburg says that work is to be begun at the western endof the great Siberian railway without delay. The first division, running from Tscheljaginsk in the government of Orenburg, to Omsk, covering a distance of 787 versts, will be ready for use, it is hoped, in the latter part of the coming fall. The opening of this part of the railway will be a great boon to Russia, as it passes through the Ural mine district and touches the famous grain district of Tobolsk. From the latter district also are sent annually 400,000 head of cattle.

ELECTRIC RAILWAYS.

SANFORD, ME.—The Mausam River R. R. Co. has been organized to build an electric road to Springvale.

BUFFALO, N. Y.—The Buffalo, North Main St. & Tonawanda Electric Ry. Co. has awarded the contract for grading to G. G. Haslip, and for electric work on the 5½ miles of road to the Field Engineering Co.

CHARLESTON, W. VA.—The Charleston Street Ry. Co. will adopt electric traction, probably by storage batteries.

ST. LOUIS, MO.—The Clayton & Forest Park Electric Ry. Co. has applied for permission to lay its tracks.

HORSE AND MOTOR RAILWAYS.

BROOKLYN, N. Y.—The New York, Mapleton & Van Pelt Manor Ry. Co. has been incorporated to build a line to New Utrecht and Flatbush. Capital stock, $50,000. A. D. Baird, J. L. Nostrand and J. W. Murphy.—The Union Street Ry. Co. and the Coney Island, Fort Hamilton & Brooklyn Ry. Co. have been granted franchises over the mayor's veto.

MERIDIAN, MISS.—A dummy line is proposed on the South Side by J. A. Lewis and W. M. Stone.

NEW COMPANIES.—Fairmount Park & Haddington Passenger Ry. Co., $50,000; Elmwood & Fairmount Park Ry. Co., $50,000; Philadelphia & Bryn Mawr Passenger Ry. Co., $50,000; all at Philadelphia; Pres., Samuel F. Gillies. Easton & South Easton Ry. Co.; Easton, Pa.; Pres., Henry A. Sage. Nanticoke & Newport Ry. Co., Nanticoke, Pa.; $50,000; Pres., Thomas D. Shea.

HIGHWAYS.

NEW YORK.—Proposals for macadamizing the White Plains road will be received until Aug. 11 by Robert Wallace, Vill. Clk., Williamsbridge.

NEW JERSEY.—The contract for 10 miles of macadamizing at Rutherford has been awarded to E. T. Gallaway at $48,000.

OHIO.—Proposals for 5.57 miles of turnpike work in Auglaize and Shelby counties will be received Aug. 19. Plans and specifications at the office of the engineer in the Court House, Wapakoneta, O.

BRIDGES, TUNNELS AND CANALS.

CAMBRIDGE, MASS.—The following bids were received for the Huron St. bridge at this place:

	Wooden floor b'ms.	Steel floor b ms.
R. F. Hawkins Iron Works, Springfield, Mass..	$5,389	$6,542
Wrought Iron Bridge Co., Canton, O.	5,525	6,575
King Bridge Co., Cleveland, O.	5,300	6,920
Rochester Bridge & Iron Works, Rochester, N. Y.	5,684	7,084
Berlin Iron Bridge Co., East Berlin, Conn.	5,900	7,170
Groton Bridge & Mfg. Co., Groton, N. Y.	5,830	7,205
Boston Bridge Works, Cambridge, Mass.	5,753	7,288

The contract was awarded July 29, 1892, to R. F. Hawkins Iron Works. The bridge was 93 ft. long and 58 ft. wide between railings.

CANALS.—Bids will be received until Aug. 23 for the work connected with sections Nos. 1 and 2 of the Soulanges Canal situated at the Cascades Point, P. Q. T. Trudeau, Ch. Engr., Dept. Rys. & Canals, Ottawa, Ont.

The Lake Washington Canal & Improvement Co., has been chartered in Washington. The incorporators are F. H. Whitworth, T. J. Hamilton and W. J. Jennings, all of Seattle, Wash. It is their purpose to construct and operate a canal or waterway connecting Lake Samamish with Lakes Union and Washington, with the waters of Puget Sound, either by way of Shilshole or Salmon Bay or by way of Smith's Cove, into Elliott Bay or Seattle Harbor, on Puget Sound, including all locks, waters and reservoirs.

WATER-WORKS.

New England.

BENNINGTON, VT.—The company is making arrangements to introduce a new supply from a spring.

MELROSE, MASS.—C. H. Long and others will act with the Water Commissioners in making investigations for an additional supply.

QUINCY, MASS.—A loan of $25,000 for 16 to 14-in. main extensions has been passed.

WATERBURY, CONN.—The Council has voted to introduce an additional supply from Mad River and its tributaries, Lindley and Chestnut Hill Brook, in accordance with the report of Engr. R. Hering.

Middle.

NEW YORK, N. Y.—All bids for the new Croton dam have been rejected. New bids will be received by the Aqueduct Commissioners until Aug. 24.

SYRACUSE, N. Y.—Bids for pipe are wanted. See advertising columns.

WHITESTONE, N. Y.—Bids for pipe are wanted, as stated in our advertising columns.

WOODSTOWN, N. J.—The contract for works has been awarded to Keen & Frazier.

ELWOOD CITY, PA.—The Elwood Water Co. has been incorporated; $5,000; Treas., S. A. Roelofs.

ERIE, PA.—Bids for the extension of $61,000 of the sixth series of Erie water bonds, due Sept. 1, 1892, will be received until Aug. 8. C. S. Clarke, Mayor. A new 10,000,000-gallon pumping engine is to be bought, it is reported.

BALTIMORE, MD.—It is reported that a company has been formed to furnish water to Curtis Bay, and that a 20 x 80-ft. stand-pipe will be built.

Southern.

NORFOLK, VA.—There is some talk of introducing a supply from Lake Drummond, Dismal Swamp.

WINSTON, N. C.—It is reported that $75,000 will be spent for improvements, including a 1,500,000-gallon pump, boiler, reservoir and five or more miles of mains. Secy., Geo. W. Hinshon.

GRIFFIN, GA.—The Council has voted to call an election for Sept. 7 to vote on issuing $35,000 of bonds to buy the private works which are to be sold at auction this fall.

North Central.

BOWLING GREEN, O.—W. S. Coon & Son, Upper Sandusky, have applied for a franchise.

EAST LIVERPOOL, O.—There is talk of a new reservoir.

MASSILLON, O.—The works of the Massillon Water Co. are for sale.

WILLOUGHBY, O.—Bids for works are wanted, as stated in our advertising columns.

WYOMING, O.—The Trustees of the Water-Works will receive bids until Aug. 15 for the construction of a reservoir by excavation, embankment, etc.; approximate capacity, 3,000,000 gallons.

ANDERSON, IND.—Snyder & Williams, contractors, Dayton, O., write us as follows in correction of the item in our last week's issue:

Our contract with the city is for two 3,000,000-gal. pumping engines, and two boilers 16 ft. long by 5 ft. diameter, and about 4½ miles of street mains from 20 to 6 ins. diameter. Contract price $50,728. The pumps will be furnished by the Hughes Steam Pump Co., of Cleveland, O.; hydrants by R. D. Wood & Co., of Philadelphia, Pa.; valves by the Eddy Valve Co., of Waterford, N. Y.; the pump house goes to S. B. Stevens, of Toledo, O., for $8,728. Total amount of awards, $50,456. J. D. Cook, Toledo, O., is engineer.

EDINBURG, IND.—It is reported that water and electric lighting plants will be established.

XENIA, IND.—Works are projected.

JACKSON, MICH.—Bids have been received as follows, only the lowest being given: Reservoir and supply well, $14,569 and $1,337, respectively, from Robert Lake and Chas. A. Howind, Jackson; 8,000,000-gallon pumping engine, $17,911, or another style, $23,475, from Deane Steam Pump Co., Holyoke, Mass.

FARMER CITY, ILL.—The people have voted 117 for and 81 against works, to cost not over $10,000. A stand-pipe is proposed.

MOUNT CARMEL, ILL.—Plans and specifications prepared by I. A. Smith, of St. Louis, have been adopted, and proposals for a franchise for water-works and electric lighting will be received until Sept. 1, by W. A. Goforth, Cy. Clk.

RICE LAKE, WIS.—The contract for works has been let to Fairbanks, Morse & Co., Chicago, and construction has been started.

Northwestern.

LEAVENWORTH, KAN.—The Leavenworth & Ft. Leavenworth Water Co. proposes to sell bonds and enlarge its works.

CRETE, NEB.—The College Heights Reservoir Co. has been incorporated to run and operate works here; $60,000 stock and limit of $40,000 to debt; Pres., Geo. H. Hastings; Secy., Geo. Dayton; Treas., J. R. Webster.

MONTROSE, SO. DAK.—There is talk of building works here.

Southwestern.

CALDWELL, TEX.—A franchise has been granted Kelly & Copeland for water, electric lighting and ice plants. It is stated that the city pays $12,000 for water used for fire protection and other purposes during a term of 25 years.

GUTHRIE, O. T.—Plans for works have been made by W. S. Reed & Co., Chicago. Bids will be received until Aug. 25. See our proposal columns. A. M. McElHinney, Mayor.

LONGMONT, COLO.—Water bonds to the amount of $70,000 have been sold.

Pacific.

KETTLE FALLS, WASH.—The people have voted $20,000 of bonds for works.

SPRINGVILLE, UTAH.—A recent fire has given rise to discussions regarding the building of works.

Canada.

TORONTO, ONT.—Bids for a 10,000,000-gallon flywheel pumping engine are wanted by the city until Aug. 22. Address Jas. Gowanlock.

ARTESIAN WELLS.

WARREN, O.—The Warren Water Co. proposes to make tests for wells.

IRRIGATION.

SAN BERNARDINO, CAL.—The Arrowhead Reservoir Co. will receive bids until Aug. 16 for a masonry dam at Little Bear Valley.

NEW COMPANIES.—Colorado Water & Power Co., Lake Co., Colo.; $150,000; Directors, C. O., O. Hyand, A. R. Block.

SEWERS.

ROCHESTER, N. H.—The City Clerk will receive bids until Aug. 9 for laying about 12 miles of 6 to 24-in. sewers.

LAWRENCE, MASS.—The Council has voted a loan of $60,000 for the construction of the Water St. sewer.

NEWBURYPORT, MASS.—The sewer bids have been rejected and new ones will be called for.

NEWTON, MASS.—The Council has ordered sewers in 11 streets, and authorized the City Treasurer to sell sewer bonds for $200,000.

BATH, N. Y.—The Village Clerk will receive bids until Aug. 8 for a 24-in. vitrified tile sewer.

GLENS FALLS, N. Y.—The sewer contract has been awarded to Benj. Van Vranken and Jas. Duell, Schenectady, at $152,828. S. E. Babcock is Chief Engineer.

NEW YORK, N. Y.—The Department of Public Works

will receive bids until Aug. 9 for sewers, eight contracts, and the Commissioner of Street Improvements in Wards 23 and 24 until Aug. 11 for two contracts, including an outlet sewer from Harlem River to Union St., with branches.

ROUSE'S POINT, N. Y.—We are informed by Alfred E. Phillips, C. E., that at the election, July 26, the proposition to construct sewers was defeated.

WATERLOO, N. Y.—The contract for preparing surveys and plans for a complete system of sewerage for the village has been awarded to S. D. Backus, Canandaigua.

BOUND BROOK, N. J.—The town has voted $53,000 for sewers.

RUTHERFORD, N. J.—The Mayor will receive bids until Aug. 15 for 2.6 miles of 9 to 24-in. pipe sewers. Wise & Watson, Passaic, Engrs.

MOBILE, ALA.—Plans and estimates for a complete system are nearly completed. It is expected that some of the work will be done this year.

CLEVELAND, O.—The Director of Public Works will receive bids until Aug. 17 for a sewer in Shipherd St. Plans have been prepared for additional sewers in several streets.

COSHOCTON, O.—A contract has been awarded to J. A. Hanlon to furnish plans and specifications for a system of sewers.

FOSTORIA, O.—The bids recently received for sewers have been rejected and the work will be readvertised.

MARION, O.—Bids will be received until Aug. 26 for about 20,000 lin. ft. of 6 to 12-in. sewers, and 22,306 lin. ft. of 6-in. subsoil drains from 6 to 18 ft. deep. H. F. Snyder, Cy. Clk.

ELKHART, IND.—Bids will be received until Aug. 24 for a sewer in State St., with laterals. G. H. Fister, Cy. Clk.

FORT WAYNE, IND.—The Council has voted to construct sewers in two streets. It is proposed to construct a large sewer in Ward 10 to cost about $70,000.

HUNTINGTON, IND.—Bids will be received until Aug. 15 for the Flint Creek sewer. H. H. Wagoner, Cy. Clk.

INDIANAPOLIS, IND.—Bids will be received until Aug. 10 for a brick sewer in Washington St.; length, 7,600 ft., with 7,000 ft. of house connection; estimated cost, $70,000; and a brick sewer in Merrill St., 2,550 ft., to cost $19,000.

TERRE HAUTE, IND.—Bids are asked until Aug. 16 for three contracts. Chas. H. Goodwin, Cy. Clk.

RHINELANDER, WIS.—A complete system of sewerage is to be constructed.

CLINTON, IA.—The City Engineer reports that a 6-ft. sewer will be required from the river to Fifth St., and then two branches, in order to drain the North Clinton slough.

DAVENPORT, IA.—Bids are asked until Aug. 13 for 19,263 lin. ft. of brick and pipe sewers. Chas. Francis, Comr. Pub. Wks.

DEADWOOD, SO. DAK.—The Council is considering the plans for the proposed system of sewerage. Geo. Sharpe is City Engineer.

OMAHA, NEB.—Bids will be received until Aug. 12 for a brick sewer in 21st St., and until Aug. 10 for sewer connections in 48 districts. P. W. Birkhauser, Chn. Bd. Pub. Wks.

TEXARKANA, ARK.—J. E. Hart and H. D. Mitchell, Cy. Engr., Hot Springs, are negotiating with the citizens to put in a system of sewerage.

DENVER, COLO.—The City Engineer reports that the proposed Rohling sewer would be 5,600 ft. in length and cost $12,700.

BUTTE, MONT.—Bids are asked until Aug. 17 for three sewers. John McCrimmon, Cy. Clk.

PORTLAND, ORE.—The Council has passed an ordinance for a sewer to drain Sunnyside and Ladd's addition. The length is about 2½ miles and the estimated cost $75,000.

MONTREAL, QUE.—The City Surveyor will receive bids until Aug. 17 for sewers in seven streets.

STREETS.

NEW HAVEN, CONN.—The Committee on Streets has voted in favor of the extension of Union Ave., to be 85 ft. wide and paved with granite blocks.

BROOKLYN, N. Y.—The Commissioner of City Works will receive bids until Aug. 10 for paving one street with cobblestones, and until Aug. 11 for paving one with granite blocks.

BUFFALO, N. Y.—The following were the lowest bids received last week for paving: Barber Asphalt Paving Co., 3 contracts, $234,772; German Rock Asphalt Co., 6 contracts, $111,485; P. B. McNaughton, 3 with stone and brick, $102,253; Buffalo Paving Co., 4 contracts, $56,506.

COHOES, N. Y.—Plans and specifications have been prepared for paving Columbia St. with granite blocks.

NEW YORK, N. Y.—The lowest bids for paving Brook Ave., from 3d Ave. to 165th St., with granite blocks was that of Andrew Low, $23,049; the lowest for two other contracts was F. Thilemann, Jr., $67,447. The Department of Public Works will receive bids until Aug. 9 for 6 contracts, and the Commissioner of Street Improvements in Wards 23 and 24 until Aug. 11 for 7 contracts.

ROCHESTER, N. Y.—The Council has passed ordinances to pave two streets with asphalt, estimated cost, $33,200, and one with Medina stone, estimated cost, $19,000.

TONAWANDA, N. Y.—The Council has voted to issue bonds for $144,595 to pave three streets with brick.

NORRISTOWN, PA.—The contract for paving Main St. with granite blocks has been awarded to Skelly & Weaver, at $41,582.

NEWPORT, KY.—Bids are asked until Aug. 11 for paving about 10 blocks with brick. B. R. Morton, Cy. Engr.

CINCINNATI, O.—Contracts have been awarded to the Trinidad Asphalt Co. at $40,369, and Jack McDermott, granite, $25,010. The Park Commissioners will receive bids until Aug. 8 for 6,000 cu. yds. grading. The Board of Administration will receive bids until Aug. 23 for the improvement of Eighth St. in connection with the viaduct. The work includes grading, filling, granite curbing, macadamizing, brick and cement paving.

FERN BANK, O.—Bids will be received until Aug. 29 for grading, macadamizing, etc., Chestnut Ave. A. S. Hobby, Village Engr., 227 Main St., Cincinnati.

SANDUSKY, O.—The City Engineer estimates the cost of the proposed paving of Central Ave. at $57,172 for asphalt, or $47,644 for brick.

TERRE HAUTE, IND.—The City Clerk will receive bids until Aug. 16 for paving two streets with Trinidad asphalt, 9,118 lin. ft.

CLINTON, IA.—The City Auditor will receive bids until Aug. 9, for brick paving.

OTTUMWA, IA.—S. H. Burton, Co. Surv., writes us that the city is about to award contracts for the improvement of nine districts. Last year the price paid for brick paving was $1.65 and $1.70 per sq. yd., and for 4 and 5-in. Berea curbing, 60 and 68 cts. per lin. ft. respectively. The city has over two miles of brick pavement and more is being laid this year. Last year about 100,000 cu. yds. of grading was done at prices from 19 to 22 cts. per cu. yd.

OMAHA, NEB.—The Special Committee has reported favorably on 41 ordinances, providing for paving to cost $308,000 and curbing $77,000. This work includes 68,000 sq. yds. of brick, 35,500 of asphalt, and 33,000 of sandstone. The Board of Public Works will receive bids until Aug. 12 for 3 contracts for curbing, 1 for grading, and 4 for paving.

DENVER, COLO.—The Board of Public Works will receive bids until Aug. 16 for grading, curbing and paving Tremont St.

SAN FRANCISCO, CAL.—The Council is considering three propositions for a boulevard, to cost $20,000, $29,500, and $100,000 respectively.

PORTLAND, ORE.—The city will soon ask for bids for three or four miles of street work, including asphalt and stone paving.

ELECTRICAL.

BURLINGTON, VT.—The Vermont Electric Co. will utilize the power at the gorge on the Winooski River. The plant is estimated to cost $60,000. W. S. Vincent is Manager of the company, and W. H. Lang will superintend the construction.

WESTFIELD, N. Y.—The Village Board has awarded the contract for an electric light plant to the Western Electric Light Co., Chicago, Ill., at $12,000, the village to furnish the building.

ELKTON, MD.—The Elkton Electric Light & Power Co. has been awarded a contract for 77 lights of 25-c. p. each. The company will use a 750-light dynamo, 80-HP. engine, and 100-HP. boiler at first, and will erect a building large enough to duplicate this machinery.

ADEL, LA.—The city will issue bonds for $10,000 for a municipal plant.

CINCINNATI, O.—The Morgan Electric Light Co. is reorganizing under the name of the Suburban Electric Light Co., and is reported about to erect a plant at Walnut Hills with a capacity of 140,000 lights to supply lights to Walnut Hills, Mount Auburn, Norwood and other suburbs.

GERMANTOWN, O.—The Council has voted to erect a plant if the cost does not exceed $1,200 per year.

EDWARDSVILLE, ILL.—The City Council will receive bids until Sept. 6 for not less than 20 arc lights of 2,000 c. p. each.

MOUNT CARMEL, ILL.—Proposals for a franchise for electric lighting will be received until Sept. 1 by W. A. Goforth, Cy. Clk.

SPRINGFIELD, MO.—The city has refused an offer of 21 additional lights at $108 per light per year, and the clerk has been instructed to advertise for bids for 100 lights for five or ten years.

NEW COMPANIES.—Titusville Electric Light & Power Co., Titusville, Pa.; $100,000; Treas., Chas. Newbert, Kittanning. Charleroi Electric Light & Power Co., Charleroi, Pa.; $5,000; Treas., B. L. Barnhart. Yuma Water & Light Co., Saco, Me.; $100,000; Pres., Chas. P. Hemenway, and Treas., John Dodd; both of Boston, Mass. North Shore Heat, Light & Power Co., Chicago, Ill.; $100,000; J. D. Cameron, J. D. R. Graham. Waitsburg Light & Power Co., Waitsburg, Wash.; $25,000; J. H. Morrow, P. A. Preston.

CONTRACT PRICES.

IRON PIPE.—St. Louis, Mo.—The lowest bid for 2,200 tons of iron pipe for the water-works department was that of Harrison & Howard, Birmingham, Ala., $25.48 per ton. The last lot of pipe cost the city $19.47 per ton.

CEMENT.—Boston, Mass.—Lt. Col. S. M. Mansfield has opened the following bids for 18,000 bbls. of American hydraulic cement: E. S. Kent, 95 cts. per bbl.; W. G. Nash, 95 cts.; Waldo Bros., 95½ cts.

BRICK.—Seattle, Wash.—The contract for 1,500,000 vitrified brick for the Lake Union sewer tunnel has been awarded to the Seattle Brick & Tile Co., at $9 per M.

STREET WORK.—Boston, Mass.—The bids for paving several streets with blocks on American cement concrete ranged from $2.32 to $3.09 per sq. yd. for paving, 23 to 42 cts. per lin. ft. for edge stones, 65 to 68 cts. per sq. ft. for brick sidewalk, $2 to $3.29 per sq. yd. for flagging on crosswalks.

Greenbush, N. Y.—Two bids were received for paving Broadway with asphalt: Trinidad Asphalt Co., $3.08 per sq. yd., and Warren-Scharf Asphalt Paving Co., $3.33; both from New York.

Washington, D. C.—The lowest bids for standard asphalt pavements, 6-in. hydraulic base, 4-in. base, and bituminous base, were those of the Schillinger Curbing & Paving Co., $2.05, $1.90 and $1.90 per sq. yd., respectively.

Steubenville, O.—A contract for a mile of fire brick paving has been awarded to J. O. Bates, at $1.39 per sq. yd.

Newark, N. J.—Paving contracts have been awarded to the Barber Asphalt Paving Co. at $2.80 and $2.87 per sq. yd., J. F. Shanley at $2.23 to $2.37, and to Thos. O'Connor at $2.20. The contracts for crosswalks were awarded at from 38 to 41 cts per sq. ft.

MISCELLANEOUS.

GAS.—Chicago, Ill.—The Vulcan Gas Co. has been incorporated by H. S. Gillette, B. L. Gorich, and others; capital, $1,000,000.

LEVEE WORK.—Clarksdale, Miss.—The Levee Board will receive bids until Aug. 10 for 11 contracts aggregating 420,000 cu. yds. of work. T. G. Dabney, Ch. Engr.

STONE.—Portland, Ore.—Bids will be received at the U. S. Engineer Office until Aug. 22 for stone for the improvement of Coos bay and harbor. Capt. T. W. Symons.

Savannah, Ga.—Bids will be received at the U. S. Engineer Office until Aug. 20 for stone, mattress, facine and pile work in Savannah harbor. Capt. O. M. Carter.

IRON WORK.—Charleston-Kanawha, W. Va.—Bids will be received at the U. S. Engineer Office until Aug. 24 for lock gates on the Great Kanawha River, embracing about 92,000 lbs. wrought iron, 57,000 lbs. cast iron, 4,000 lbs. steel and bronze. Col. Wm. P. Craighill.

DREDGING.—Detroit, Mich.—Col. O. M. Poe will soon advertise for bids for dredging in the Range River.

MANUFACTURING AND TECHNICAL.

LOCOMOTIVES.—The Rogers Locomotive Works, Paterson, N. J., have built 1 eight-wheel and 1 double-end suburban tank engine for the New York & Northern. The Portland Co., Portland, Me., and the Rhode Island Locomotive Works, Providence, R. I., have built several engines for the Maine Central. The Grant Locomotive Works, Chicago, Ill., are repairing 3 engines for the Elgin, Joliet & Eastern, and will build 5 consolidation engines for stock. The Schenectady Locomotive Works, Schenectady, N. Y., have completed an order for 20 ten-wheel passenger engines for the Chicago, St. Paul, Minneapolis & Omaha.

CARS.—Jackson & Sharp, Wilmington, Del., have an order for 13 passenger cars and 2 chair cars for the Jacksonville, St. Augustine & Halifax River. The Ohio Falls Car Co., Jeffersonville, Ind., is building 600 freight cars for the Ohio Southern and 500 for the Pittsburg, Cincinnati, Chicago & St. Louis. The Gilbert Car Mfg. Co., Troy, N. Y., is building several motor cars for the Troy City Ry. The Terre Haute Car Mfg. Co., Terre Haute, Ind., has an order for 1,000 freight cars for the St. Louis, Vandalia & Terre Haute. The Crossen Car Mfg. Co., Coburg, Ont., is building 12 sleeping cars for the Canadian Pacific, and is building several passenger and freight cars.

STEEL CASTINGS.—The Shickle, Harrison & Howard Iron Co. has put in a plant for making steel castings at St. Louis, Mo. Steel will be manufactured by the basic process.

THE STEARNS MFG. CO., of Erie, Pa., has recently added to its already extensive works a department for the manufacture of stand-pipes, structural iron, etc., and placed Mr. D. J. Lewis, M. E., in charge, with headquarters in the Rookery Building, Chicago. This company manufacturers the Woodbury high speed engines, saw mill machinery, etc., and has branch offices in all large cities. Mr. A. F. Griswold is manager of the Chicago office.

THE COLUMBIAN STEAM PUMP CO., 7 and 9 S. Jefferson St., Chicago, has succeeded the Ayer Steam Vacuum Pump Co., and will continue to manufacture the Ayer standard pumps at the above address. It will also make a specialty of irrigation pumps. A contract for a pumping plant of 3,000,000-gallons daily capacity has recently been awarded to this company by the city of Chicago for its sewage plant at 94th St. and Stony Island Ave. It is to be in operation about Aug. 5. The officers of the new company are: Prest., H. C. Davis; Secy. and Treas., L. M. Randall.

NEW COMPANIES.—Illinois Engineering & Construction Co., Chicago, Ill.; $100,000; J. C. Slocum, E. J. Teslon and H. S. Wicks. Northern Central Construction Co., East St. Louis, Ill.; $200,000; E. H. Webster, L. E. Irwin and W. R. Rogers. Powers Balance Engine Co., Chicago, Ill.; $1,000,000; E. B. Harned, George Sirwright and A. H. Hollenbeck. Joyce Surveying Co., St. Louis, Mo.; $10,000; J. G. Joyce, Wm. J. Joyce and J. T. Dodds. Rapid Safety Filter Co., St. Louis, Mo.; $250,000; H. A. Gwinzburg, S. J. Oppheim and C. H. Blanchard. Powell Steel Tunnel Co., Chicago, Ill.; $1,000,000; H. S. Gillette, J. R. D. Graham and B. L. Gorich. Illinois Railway Construction Co., Chicago, Ill.; W. E. Shaw, J. M. Armstrong and W. P. Dewey.

CURRENT PRICES.

RAILS.—New York: $30 at Eastern mills, $30.75 at tidewater; old rails, $20 for iron and $17 for steel. Pittsburg: $30; old rails, $19 for iron and $15 to $16 for steel. Chicago: $31 to $32.50; old rails, $18 for iron and $12.50 to $14 for steel.

TRACK MATERIALS.—New York: steel angle bars, 1.6 to 1.65 cts.; spikes, 1.9 to 2 cts.; track bolts, 2.5 to 2.6 cts. with square and 2.7 to 2.8 cts. with hexagon nuts. Pittsburg: splice bars, 1.75 to 1.77 cts. for iron and 1.8 cts. for steel; iron or steel spikes, 2.15 cts.; iron track bolts, 2.7 cts. with square and 2.8 cts. with hexagon nuts. Chicago: splice bars, 1.75 to 1.8 cts. for iron and steel; spikes, 2.05 to 2.1 cts.; track bolts, 2.65 to 2.7 cts. with hexagon nuts.

PIPE.—Cast iron, $20 to $30 per ton. Wrought iron, discounts as follows, at Pittsburg: 57¼ and 47½ per cent. on black and galvanized butt-welded; 67½ and 55 per cent. on black and galvanized lap-welded. Casing 55 per cent.

FOUNDRY PIG IRON.—New York: $14 to $15.50. Pittsburg: $13.25 to $14.50; Chicago: $13.50 to $15.

LEAD.—New York: 4 to 4.05 cts. Chicago: 4 cts. St. Louis, 3.9 to 3.95 cts.

STRUCTURAL MATERIAL.—New York: beams, 2.2 to 2.5 cts. for large lots, and 2.4 to 2.75 cts. for small lots, channels, 2.25 to 2.5 cts.; angles, 1.85 to 2 cts.; tees, 2.3 to 2.75 cts.; sheared iron plates, 1.9 to 2.25 cts.; steel plates; 1.85 to 1.9 cts. for tank, 2 to 2.25 cts. for shell, 2.5 to 2.65 cts. for flange. 3 to 3.25 cts. for firebox. Pittsburg: beams, 1.9 to 1.95 cts. for large lots, and 2 to 2.05 cts. for small lots; channels, 1.9 to 1.95 for large lots, and 2 to 2.05 cts. for small lots; angles, 1.8 to 1.9 cts.; tees, 2.35 cts.; universal mill plates, 1.75 to 1.8 cts. for iron and 1.8 to 1.9 cts. for steel; sheared steel bridge plates, 1.95 to 2.05 cts.; refined bars, 1.7 to 1.75 cts. for iron and steel; steel plates, 1.75 to 1.85 cts. for tank, 2 to 2.1 cts. for shell, 2 to 2.1 cts. for flange, 3.5 to 3.75 cts. for firebox. Chicago: beams, 2.1 cts. for large lots, and 2.5 cts. for small lots; channels, 2.15 to 2.25 cts.; angles, 2.2 to 2.25 cts.; tees, 2.4 to 2.6 cts.; universal plates, 1.9 cts.; sheared steel plates, 2.25; steel plates, 2.3 to 2.4 cts. for tank, 2.0 to 2.75 cts. for shell, 2.9 to 3 cts. for flange.